



U.S. Environmental Protection Agency Region 2

SDMS Document



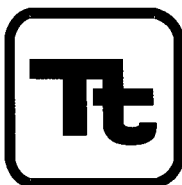
109568

Response Action Contract

FINAL
FEASIBILITY STUDY REPORT
FOR
SOILS AT
ROCKAWAY BOROUGH WELLFIELD
SUPERFUND SITE
WALL STREET/EAST MAIN STREET SITE
MORRIS COUNTY, NEW JERSEY

AUGUST 2006

Contract Number: 68-W-98-214



TETRA TECH EC, INC.

400001

USEPA WORK ASSIGNMENT NUMBER: 144-RICO-0281
USEPA CONTRACT NUMBER: 68-W-98-214
TETRA TECH EC, INC.
RAC II PROGRAM

FINAL
FEASIBILITY STUDY REPORT
FOR
SOILS AT
ROCKAWAY BOROUGH WELLFIELD
SUPERFUND SITE
WALL STREET/EAST MAIN STREET SITE
MORRIS COUNTY, NEW JERSEY

AUGUST 2006

NOTICE

THE INFORMATION PROVIDED IN THIS DOCUMENT HAS BEEN FUNDED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA) UNDER RAC II CONTRACT NUMBER 68-W-98-214 TO TETRA TECH EC, INC. (TtEC). THIS DOCUMENT HAS BEEN FORMALLY RELEASED BY TtEC TO THE EPA. THIS DOCUMENT DOES NOT, HOWEVER, REPRESENT EPA POSITION OR POLICY, AND HAS NOT BEEN FORMALLY RELEASED BY THE EPA.



TETRA TECH EC, INC.

9 August 2006
RAC II-2006-164

Mr. Brian Quinn
Work Assignment Manager
U.S. Environmental Protection Agency
290 Broadway, 19th Floor
New York, NY 10007-1866

**SUBJECT: USEPA RAC II CONTRACT NUMBER 68-W-98-214
WORK ASSIGNMENT NUMBER 144-RICO-0281
ROCKAWAY BOROUGH WELLFIELD RI/FS
FINAL FEASIBILITY STUDY REPORT**

Dear Mr. Quinn:

Enclosed please find one unbound and two bound copies of the final Feasibility Study (FS) Report for the subject site. I have also enclosed an electronic copy on CD.

Please contact me at (973) 630-8538 or louis.hahn@tteci.com if you have any other questions or comments.

Sincerely,

A handwritten signature in black ink, appearing to read 'Louis H. Hahn', with a long horizontal flourish extending to the right.

Louis H. Hahn
RAC II Project Manager

Attachment

cc: M. Parra, NJDEP



1000 The American Road, Morris Plains, NJ 07950
Tel 973.630.8000 Fax 973.630.8025
www.tteci.com

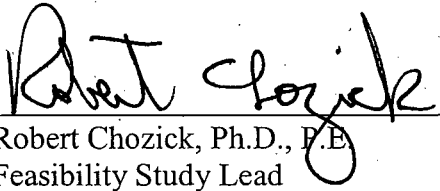
400003

USEPA WORK ASSIGNMENT NUMBER: 144-RICO-0281
USEPA CONTRACT NUMBER: 68-W-98-214
TETRA TECH EC, INC.
RAC II PROGRAM

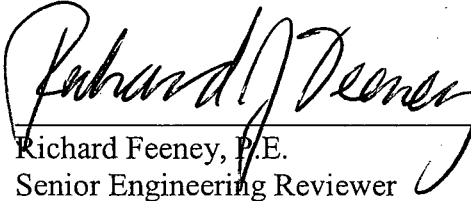
FINAL
FEASIBILITY STUDY REPORT
FOR
SOILS AT
ROCKAWAY BOROUGH WELLFIELD
SUPERFUND SITE
WALL STREET/EAST MAIN STREET SITE
MORRIS COUNTY, NEW JERSEY

AUGUST 2006

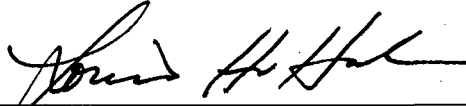
Prepared by:


Robert Chozick, Ph.D., P.E.
Feasibility Study Lead
Tetra Tech EC, Inc.

Reviewed by:


Richard Feeney, P.E.
Senior Engineering Reviewer
Tetra Tech EC, Inc.

Reviewed by:


Louis H. Hahn, CHMM
Project Manager
Tetra Tech EC, Inc.

Approved by:



William R. Colvin, PMP, P.G., CHMM
RAC II Program Manager
Tetra Tech EC, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS

SECTION	PAGE
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION.....	1-1
1.1 Purpose and Organization of the Report	1-1
1.2 Site Description and History	1-2
1.2.1 Site Location and Description.....	1-2
1.2.2 Site History	1-2
1.2.3 Physical Characteristics	1-4
1.2.3.1 Surface Features	1-4
1.2.3.2 Climate	1-5
1.2.3.3 Demography and Land Use.....	1-5
1.2.3.4 Cultural Resources	1-5
1.2.3.5 Habitats (Wetlands, Terrestrial, and Aquatic).....	1-5
1.2.3.6 Wildlife	1-6
1.2.3.7 Geology	1-6
1.2.3.8 Hydrogeology.....	1-7
1.3 Remedial Investigation and Focused Field Sampling Summary.....	1-8
1.3.1 Nature and Extent of Contamination.....	1-8
1.3.2 Contaminant Fate and Transport.....	1-9
1.3.3 Human Health Risk Assessment.....	1-10
1.3.4 Ecological Risk Assessment.....	1-11
2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES	2-1
2.1 Introduction.....	2-1
2.2 Remedial Action Objectives.....	2-1
2.2.1 Chemicals of Concern.....	2-1
2.2.2 Exposure Pathways Based on Risk Assessment	2-2
2.2.3 ARARs and TBCs.....	2-2
2.2.4 Identification of Remedial Action Objectives.....	2-3
2.3 General Response Actions	2-3
2.4 Identification and Screening of Technologies and Process Options	2-4
2.4.1 Identification and Screening of Technologies.....	2-4
2.4.1.1 Screening of Soil Remediation Technologies	2-4
2.4.2 Evaluation and Selection of Representative Process Options	2-14
3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES.....	3-1
3.1 Development of Soils Remedial Alternatives	3-1
4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES.....	4-1
4.1 Evaluation Criteria	4-1
4.1.1 Overall Protection of Human Health and the Environment	4-2
4.1.2 Compliance with ARARs.....	4-2
4.1.3 Long-Term Effectiveness.....	4-2
4.1.4 Reduction of Toxicity, Mobility, and/or Volume	4-2
4.1.5 Short-Term Effectiveness.....	4-3
4.1.6 Implementability	4-3
4.1.7 Cost	4-3

TABLE OF CONTENTS (Cont'd)

SECTION	PAGE
4.2 Detailed Analysis of Alternatives	4-3
4.2.1 Alternative S-1: No Action	4-3
4.2.1.1 Overall Protection of Human Health and the Environment	4-4
4.2.1.2 Compliance with ARARs	4-4
4.2.1.3 Long-Term Effectiveness	4-4
4.2.1.4 Reduction of Toxicity, Mobility, and/or Volume	4-4
4.2.1.5 Short-Term Effectiveness	4-4
4.2.1.6 Implementability	4-4
4.2.1.7 Cost	4-4
4.2.2 Alternative S-2: Limited Action	4-4
4.2.2.1 Overall Protection of Human Health and the Environment	4-5
4.2.2.2 Compliance with ARARs	4-5
4.2.2.3 Long-Term Effectiveness	4-5
4.2.2.4 Reduction of Toxicity, Mobility, and/or Volume	4-5
4.2.2.5 Short-Term Effectiveness	4-5
4.2.2.6 Implementability	4-5
4.2.2.7 Cost	4-6
4.2.3 Alternative S-3: <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	4-6
4.2.3.1 Overall Protection of Human Health and the Environment	4-6
4.2.3.2 Compliance with ARARs	4-6
4.2.3.3 Long-Term Effectiveness	4-7
4.2.3.4 Reduction of Toxicity, Mobility, and/or Volume	4-7
4.2.3.5 Short-Term Effectiveness	4-7
4.2.3.6 Implementability	4-8
4.2.3.7 Cost	4-8
4.2.4 Alternative S-4: Excavation with Off-Site Treatment and/or Disposal with SVE	4-8
4.2.4.1 Overall Protection of Human Health and the Environment	4-9
4.2.4.2 Compliance with ARARs	4-9
4.2.4.3 Long-Term Effectiveness	4-9
4.2.4.4 Reduction of Toxicity, Mobility, and/or Volume	4-10
4.2.4.5 Short-Term Effectiveness	4-10
4.2.4.6 Implementability	4-10
4.2.4.7 Cost	4-11
4.3 Comparative Analysis of Alternatives	4-11
4.3.1 Overall Protection of Human Health and the Environment	4-11
4.3.2 Compliance with ARARs	4-11
4.3.3 Long-Term Effectiveness	4-12
4.3.4 Reduction of Toxicity, Mobility, and/or Volume	4-12
4.3.5 Short-Term Effectiveness	4-12
4.3.6 Implementability	4-13
4.3.7 Cost	4-13
5.0 REFERENCES	5-1
6.0 GLOSSARY OF ACRONYMS AND ABBREVIATIONS	6-1

LIST OF TABLES

- 1-1 Summary of April 2006 Soil Sampling Results
- 2-1 Chemical-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements To Be Considered (TBCs)
- 2-2 Location-Specific Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements To Be Considered (TBCs)
- 2-3 Action-Specific Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements To Be Considered (TBCs)
- 2-4 General Response Actions, Technology Types, and Process Options for Soils
- 2-5 Initial Screening of Remedial Technologies and Process Options for Soils
- 2-6 Evaluation of Process Options for Soils
- 4-1 Comparative Analysis of Remedial Alternatives for Soil

LIST OF FIGURES

- 1-1 Site Location Map
- 1-2 Study Area
- 1-3 Tetrachloroethene in Surface Soil – Including 2006 Supplemental Data
- 1-4 Tetrachloroethene in Soil Gas
- 4-1 Hot Spot Excavation and Conceptual SVE System layout (Alternative S-3)
- 4-2 Contingency SVE System Layout
- 4-3 Conceptual Excavation Area (Alternative S-4)

LIST OF APPENDICES

- A Major Facilities and Construction Components
- B Conceptual Costs
- C Archeological Trip Report

EXECUTIVE SUMMARY

Tetra Tech EC, Inc. (TtEC) has prepared this Feasibility Study (FS) Report for the Wall Street/East Main Street Site (the Site) of the Rockaway Borough Wellfield Superfund Site located in Rockaway Borough, New Jersey. This report has been prepared for the United States Environmental Protection Agency (EPA) in response to Work Assignment Number 144-RICO-0281, issued under EPA RAC II Contract Number 68-W-98-214. This FS Report was prepared pursuant to the EPA-approved Final Work Plan (TtFW, 2003), Quality Assurance Project Plan (TtFW, 2002), and current EPA guidance.

Rockaway Borough (the Borough) is located in Central Morris County, New Jersey. The Borough is approximately 2.1 square miles in size and is located 10 miles north of Morristown and 25 miles northwest of Newark in the north-central portion of the state. Rockaway Borough is bordered to the north and west by Rockaway Township and to the east and south by Denville. Land use in the Borough is a mix of commercial, industrial, and residential.

The nature and extent of soil contamination present at the Wall Street/East Main Street Site was determined based on the results of a Site Reconnaissance, Field Investigation, and Focused Field Sampling. In addition, an evaluation of available historical information and the results of the geophysical and soil gas surveys completed during the Site Reconnaissance was performed to assist in the identification of potential contaminant source areas.

PCE is the primary contaminant at the Site and is present at elevated concentrations in the soil (*i.e.*, up to 14,000 $\mu\text{g/kg}$ in the surface soil and 730 $\mu\text{g/kg}$ in the subsurface soil). These PCE concentrations were found in the vicinity of Lusardi's Cleaners and the parking lot northwest of Wholly Scrap! (a scrapbook shop).

Four areas of the Site were evaluated in a Baseline Human Health Risk Assessment (BHHRA): Lusardi's Basement, Lusardi's Backyard, Memorial Park, and the Former Foundry Property. Projected Reasonable Maximum Exposure (RME) and Central Tendency (CT) risks were calculated to be less than or within EPA's range of acceptable cancer risks and below the EPA Hazard Index (HI) benchmark. EPA is currently conducting indoor air sampling in Rockaway Borough to assess the potential risks from vapor migration into indoor air. The findings of the Screening Level Ecological Risk Assessment (SLERA) indicated that concentrations of inorganics are comparable to background concentrations and there is minimal terrestrial habitat; the risks to ecological receptors are low. Based on these findings, a Baseline Ecological Risk Assessment was not performed.

Based on the results of the BHHRA, the SLERA, and a comparison of contaminant concentrations to regulatory cleanup criteria, remedial action objectives (RAOs) were identified and remedial technologies were screened, evaluated, and combined into soil remedial alternatives for the Site. The following four remedial alternatives were developed for contaminated soil: No Action (S-1); Limited Action (S-2); Hot Spot Excavation and *In Situ* Soil Vapor Extraction (SVE) (with contingency for further SVE treatment) (S-3); and Excavation with Off-Site Disposal (with contingency for SVE treatment) (S-4).

Overall Protection of Human Health and the Environment: Implementation of Alternative S-1 or Alternative S-2 would not achieve the RAOs because the potential for migration of PCE from contaminated soil to groundwater and the potential for indoor air exposures would persist. Alternative S-2 would potentially provide some risk reduction through institutional controls such as land use restrictions and public education. Alternative S-3 and Alternative S-4 are more protective of human health and the environment than Alternatives S-1 and S-2, since Alternatives S-3 and S-4 would treat or remove the PCE-contaminated soil. Alternative S-4 may be somewhat more protective than Alternative S-3, since more contaminated soils would be removed from the site. Alternatives S-3 and S-4 both have the potential to leave behind some residual contamination due to treatment limitations (S-3) and inaccessible areas beneath the buildings (S-3 and S-4). Contingency plans for Alternatives S-3 and S-4 are included to address additional contamination beneath Lusardi's Cleaners if encountered during the remedial action.

Compliance with ARARs: Alternative S-1 and Alternative S-2 would not comply with chemical-specific TBCs, since contaminated soil would remain on-site above the NJDEP Soil Cleanup Criteria (SCC). Since the system would operate until soil concentrations were below the TBCs, Alternative S-3 would comply with chemical-specific To Be Considered (TBCs) for both soil, with the possible exception of some areas beneath the buildings. Alternative S-4 would also comply with chemical-specific TBCs, with the possible exception of areas beneath the buildings. Alternative S-1 and Alternative S-2 would not trigger location- or action-specific ARARs as no active remediation would take place. Alternative S-3 and Alternative S-4 are not expected to trigger location-specific ARARs, as no on-site disposal will take place and the remediation will not take place within sensitive environs. Alternatives S-3 and S-4 would trigger action-specific ARARs, as active remediation will take place.

Long-Term Effectiveness: The magnitude of residual risks is highest for Alternatives S-1 and S-2. Alternative S-2 relies on land use restrictions and public education programs aimed at informing the public about potential hazards posed by exposure to contaminants in the soil. Alternatives S-3 and S-4 are permanent remedies that mitigate the ongoing source of groundwater contamination and the potential for indoor air exposures through active remediation.

Reduction of Toxicity, Mobility, or Volume: Neither Alternative S-1 nor Alternative S-2 provides a reduction of toxicity, mobility, or volume of contaminated soils. Alternatives S-3 and S-4 would reduce contaminant mobility through removal and disposal or regeneration of the spent GAC, and removal and disposal of soils at approved off-site facilities.

Short-Term Effectiveness: No short-term adverse impacts to workers or the community would be expected for Alternatives S-1 or S-2. Alternatives S-3 and S-4 would cause an increase in truck traffic, noise, and potentially dust in the surrounding area during remedial construction. Air monitoring, engineering controls, personal protective equipment, and safe work practices would be used to address potential impacts to workers and the community. No environmental impacts are expected from Alternatives S-1 or S-2. For Alternative S-3 and if contingency SVE were implemented air emission controls would be needed. For Alternatives S-3 and S-4, erosion controls and dust control measures would be needed. Alternative S-1 would not require any time to implement. Alternative S-2 would require approximately six months. Alternative S-3 (and

potentially Alternative S-4) would require one to two years to implement. Pilot testing, if performed, would require an additional six months to one year. Alternative S-4 without implementing the SVE contingency would require approximately six months for design, and an additional three to six months to implement.

Implementability: Alternatives S-1 and S-2 include periodic reviews and inspections as a means of monitoring the effectiveness of the remedy. Consulting services associated with these reviews are readily available. The technical components of Alternatives S-3 and S-4 would be easily implemented using conventional construction equipment and materials; however, some specialized techniques may be required for excavation in close proximity to building foundations. Equipment and installation vendors for the SVE system in Alternatives S-3 and S-4 are readily available. Off-site disposal facilities are available for the disposal of the contaminated media for Alternatives S-3 and S-4.

Cost: Alternative S-1 would have no cost. Alternative S-2 would have a present worth cost of \$27,000. Alternative S-3 would have a present worth cost of \$360,000 with a predicted cost of \$50,000 for contingency SVE treatment. Alternative S-4 would have a present worth cost of \$46,000 with a predicted cost of \$274,000 for contingency SVE treatment.

1.0 INTRODUCTION

Tetra Tech EC, Inc. (TtEC) has prepared this Feasibility Study (FS) Report for the Wall Street/East Main Street Site (the Site) of the Rockaway Borough Wellfield Superfund Site located in Rockaway Borough, New Jersey. This report has been prepared for the United States Environmental Protection Agency (EPA) in response to Work Assignment Number 144-RICO-0281, issued under EPA RAC II Contract Number 68-W-98-214. This FS Report was prepared pursuant to the EPA-approved Final Work Plan (TtFW, 2003), Quality Assurance Project Plan (TtFW, 2002), and current EPA guidance.

1.1 Purpose and Organization of the Report

The purpose of this FS was to develop and screen feasible alternatives to remediate soil contamination present at the Site. In the Remedial Alternatives Screening Technical Memorandum dated March 2005, combinations of technologies were assembled into alternatives for remediation of the contamination. Four soil alternatives were retained and underwent a detailed evaluation in the Draft Remedial Alternatives Evaluation Technical Memorandum dated October 2005 (revised July 2006).

This FS Report was prepared utilizing data and information presented in the Remedial Investigation (RI) Report (TtFW, 2005a), the Remedial Alternatives Screening Technical Memorandum (TtFW, 2005b), and the Remedial Alternatives Evaluation Technical Memorandum (TtEC, 2005), and incorporates data from the Focused Field Sampling completed in April 2006. This FS Report follows the general process outlined in EPA *A Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA – Interim Final*, (EPA, 1988) and is divided into six sections, Sections 1.0 through 6.0, as follows:

Section 1.0 (Introduction) – provides background information on the Site, including location and features, geology and hydrogeology, history, surrounding area, and past regulatory history. Summaries of the nature and extent of contamination and baseline risk assessments are also included in this section.

Section 2.0 (Identification and Screening of Technologies) – presents the technical criteria and the site-specific requirements that were used in the technology screening and selection process. The results of the remedial technology screening and a summary of the remedial action objectives are also presented in this section.

Section 3.0 (Development and Initial Screening of Alternatives) – presents the remedial alternatives developed by combining the technologies that passed the screening in Section 2.0.

Section 4.0 (Detailed Analysis of Remedial Alternatives) – presents a detailed description and evaluation of each of the alternatives identified in Section 3.0. The analysis of each alternative was performed against the first seven of the nine assessment criteria (EPA, 1988). The remaining two evaluation criteria (state acceptance and public acceptance) will be evaluated in the Proposed Plan and Record of Decision after receiving comments generated during the public review period for this document. This section also presents the comparative analysis of alternatives relative to the evaluation criteria.

Section 5.0 (References) – provides a list of the references and previous studies cited in this report.

Section 6.0 (Acronyms) – provides a list of the acronyms used in the report.

This FS Report has three appendices: Appendix A - provides the major construction components of the remedial alternatives; Appendix B - provides the estimates of the capital and operation and maintenance costs for each of the remedial alternatives; and Appendix C - includes the archaeological monitoring trip report prepared based on the Focused Field Sampling completed in April 2006.

1.2 Site Description and History

This section provides a description of the Site location and history. More detailed discussions can be found in the RI Report.

1.2.1 Site Location and Description

Rockaway Borough (the Borough) is located in central Morris County, New Jersey. The Borough is approximately 2.1 square miles in size and is located 10 miles north of Morristown and 25 miles northwest of Newark in the north-central portion of the state. Rockaway Borough is bordered to the north and west by Rockaway Township and to the east and south by Denville (see Figure 1-1). Land use in the Borough is a mix of commercial, industrial, and residential.

The Rockaway Borough Wellfield Superfund Site includes three municipal water supply wells (Nos. 1, 5, and 6), which are located off Union Street in the eastern section of the Borough (see Figure 1-1). The Rockaway River is located approximately 750 feet south of the center of the wellfield. The municipal wells range in depth from 54 to 84 feet below ground surface (bgs) and are located in a glacial aquifer. The EPA designated the aquifer a sole-source aquifer for the Borough and surrounding communities. The wells supply potable water to approximately 11,000 people.

The Site is primarily a commercial area in the heart of downtown Rockaway Borough (see Figure 1-2). Businesses located in the area include dry cleaning, auto body repair, auto service and repair, banking, hardware, hair dressing, convenience stores, and food establishments. In addition, Borough Police and Fire Departments and municipal parking lots are located in this area. A recreational area, known as Memorial Park, is also located in this portion of the Borough.

The Study Area considered for this FS includes the suspected source of the plume, Lusardi's Cleaners, Inc. (Lusardi's), located at 2 Wall Street. In addition, the Study Area includes a portion of the former Morris Canal, the former M. Hoagland Union Foundry and Machine Shop, auto body and service stations, and a second dry cleaning facility. The Study Area was developed during the project planning task based on the preliminary results of the Site visit conducted on 11 October 2001 and a preliminary evaluation of existing data discussed in Section 3.1.6 of the approved Work Plan (TtFW, 2003).

1.2.2 Site History

Rockaway Borough was incorporated in 1894. According to Sanborn Fire Insurance Maps (Sanborn maps) dated as early as 1886 and the Rockaway Borough History webpage, the Wall Street/East Main Street area of the Borough developed significantly during the late 1880s, due in part to the construction of the Morris Canal (the Canal). The Rockaway Borough History webpage states "the canal became a dominant town feature, lined with commercial and industrial undertakings." The Morris Canal passed under Wall Street and through the present municipal parking lot and Memorial Park (see Figure 1-2). The Canal is depicted as the "Bed of the Former Morris Canal" on the 1924, 1944, and 1951 Sanborn maps (see Appendix E of the RI Report). The bed of the Canal has been filled and developed into the aforementioned municipal parking lot and Memorial Park since 1951, according to aerial photographs.

A former foundry, the M. Hoagland Union Foundry and Machine Shop, was located on the property currently occupied by the Borough Police Department and a scrapbook shop (*i.e.*, Wholly Scrap!). The Sanborn maps depict the presence of the former foundry through 1924; however, the foundry is no longer shown on the Sanborn map in 1944. Another notable feature of the area during the late 1800s and early 1900s is the Opera House, formerly located in the building presently occupied by Lusardi's, located at 2 Wall Street.

The following table provides a brief chronological summary of the investigations and other activities related to the Rockaway Borough Wellfield Superfund Site, with emphasis on the Wall Street/East Main Street Site, where possible.

Date	Event
1979	Contamination was discovered in groundwater in the neighboring Rockaway Township Wells Site.
March 1980	The New Jersey Department of Environmental Protection (NJDEP) began sampling Rockaway Borough's three water supply wells (Municipal Well Nos. 1, 5, and 6). Volatile Organic Compound (VOC) contaminants, including Tetrachloroethene (PCE), Trichloroethene (TCE), 1,1,1-Trichloroethane (1,1,1-TCA), trans-1,2-Dichloroethene (1,2-DCE), toluene, chloroform, and bromodichloromethane, were detected. The primary contaminants detected were PCE and TCE.
1981	Rockaway Borough began treating the municipal water supply using a three-bed granular activated carbon adsorption treatment system.
December 1982	The Rockaway Borough Wellfield Superfund Site was placed on EPA's National Priorities List (NPL) of Superfund Sites.
August 1983	A Remedial Action Master Plan (RAMP) was prepared and a cooperative agreement was executed between EPA and NJDEP, which initiated a Phase I RI/FS that was conducted by Science Applications International Corporation (SAIC) under contract with NJDEP.
March 1985	SAIC initiated the Phase I RI/FS to investigate the wellfield, known as Operable Unit One (OU-1). A draft final report was prepared in August 1986. SAIC performed a soil gas survey throughout Rockaway Borough in an attempt to identify sources of contamination. The draft final report prepared by SAIC stated that "the most concentrated (100 to 1000 parts per billion, or ppb) portion of the PCE soil gas plume was located west of the wellfield near the intersection of East Main and Wall Streets." The highest concentration of PCE in soil gas (<i>i.e.</i> , 3,100 ppb) was detected in a sample collected in the vicinity of the municipal parking lot east of Wall Street.
29 September 1986	A Record of Decision (ROD) for OU-1 was signed, based on the SAIC RI/FS. The ROD recommended continued treatment at the municipal wells and additional investigations to identify sources and determine the extent of contamination.
May 1988	The NJDEP Department of Hazardous Site Mitigation (DHSM) formally transferred the lead on the Rockaway Borough Wellfield Superfund Site to EPA.
August 1990 – July 1991	ICF Technology, Inc. (ICF) conducted an RI/FS on an area known as OU-2 to investigate the plumes of groundwater contamination. ICF issued a draft final report on 18 July 1991. The groundwater contamination source discussion of the ICF draft final report states "During the Phase I investigation performed in 1986, PCE contamination was observed in SAI-2 (365 ppb) in the area of Wall Street and East Main Street. A local dry cleaning facility (Lusardi's Cleaners) was identified as a potential source of this PCE contamination. This was supported by the analytical results from SAI-2 and that fact that PCE is widely used in the dry cleaning industry." The draft final report discusses the difficulty ICF had installing two wells (RBW-1 and RBW-1A) in the vicinity of the dry cleaning facility. According to the report, the wells were installed approximately 100 feet downgradient of the dry cleaning facility, in the

Date	Event
	municipal parking lot. PCE was detected in groundwater collected from both the wells. The report states, "Although this contamination may be a result of poor disposal practices or sloppy housekeeping at Lusardi Cleaners or a similar industry in the past, Lusardi's Cleaners cannot be positively identified at this time as a source of the Borough's municipal well contamination."
September 30, 1991	A ROD for OU-2 was signed based on the ICF draft final report. EPA selected a remedial action which involved extracting and treating contaminated groundwater to restore the aquifer. EPA also stated that additional RI/FS activities should be conducted to determine the sources of the contamination.
1994	Thiokol Corporation, now Alliant Tech Systems, entered into a Consent Decree with EPA which addressed remediation of the plume of groundwater contamination emanating from the Klockner property. This plume is primarily composed of TCE. The Klockner property has been identified as a source of groundwater contamination in the Rockaway Borough. This property is located to the northeast, approximately ½ mile from the Wall Street/East Main Street Site.
7 October 1995	An Administrative Order on Consent (AOC) between Klockner and EPA became effective.
1995	EPA reached a settlement with the remaining Potentially Responsible Parties (PRPs) for the reimbursement of certain past response costs. The proposed settlement was published in the Federal Register on March 3, 1995. Lusardi's Cleaners, Inc. is included as one of the PRPs in the proposed settlement.
1996 – 2006	Conestoga-Rovers & Associates (CRA) is conducting a remedial design study on behalf of Alliant Tech Systems at the Klockner property. The remedial design also includes the PCE plume emanating from the Wall Street/East Main Street Site.
1996 – 2006	The Whitman Companies, Inc. are investigating potential sources of soil and groundwater contamination on behalf of Klockner. These activities are being conducted under OU-3, Source.
June 2003 – November 2003	TtEC, on behalf of EPA, completed a remedial investigation of the Wall Street/East Main Street site.
April 2006 – May 2006	TtEC, on behalf of EPA, completed a Focused Field Sampling program at the Wholly Scrap! property to define the horizontal and vertical characterization of PCE in soil at RI boring D4.

1.2.3 Physical Characteristics

This section provides a description of the Site area in terms of surface features, climate, demography, land use, geology, hydrogeology, ecology, and cultural resources. More detailed discussions can be found in the RI Report.

1.2.3.1 *Surface Features*

Rockaway Borough is located in the easternmost portion of the New Jersey Highlands physiographic region, in Morris County, New Jersey. The highlands consist of rolling hills rising to elevations between 500 and 900 feet. The Rockaway River flows east through the central portion of Rockaway Borough. The Wall Street/East Main Street Site includes an eight block area located in the north central portion of Rockaway Borough, containing 62 properties. The area includes several surviving landscape features associated with Morris Canal Plane No. 6 East, the Former Morris Canal, and dams in the Rockaway

River. Features associated with the Morris Canal included the former canal prism, Upper Basin at Plane No. 6, the former towpath, a stone culvert, and other architectural features.

1.2.3.2 Climate

According to the Office of the New Jersey State Climatologist website, New Jersey has five distinct climate regions. Rockaway Borough is located within the climate region referred to as the Northern Zone which is characterized as having a continental type climate with minimal influence from the Atlantic Ocean, except when the winds contain an easterly component. Prevailing winds are from the southwest in summer and from the northwest in winter. The median annual rainfall is 50.7 inches and annual snowfall averages 40 to 50 inches. During the warm season, thunderstorms are responsible for most of the rainfall.

1.2.3.3 Demography and Land Use

Based on the 2000 Census, the Borough is occupied by 6,473 people. The eight block area comprising the Wall Street/East Main Street Site includes portions of the historic commercial and residential center of the Borough. Land use in the Borough is a mix of commercial/industrial and residential. Many historic structures and industrial facilities have been demolished, including the Union Foundry and Machine Works, located south and east of the canal. This facility was demolished in 1930 and is now occupied by a municipal playground, a scrap book shop (Wholly Scrap!) the Rockaway Borough Police Department, and parking. Properties once associated with the canal were filled and are presently used for roads, parking areas, and municipal parks.

1.2.3.4 Cultural Resources

Based on the presence of the Morris Canal and other cultural resources within the Site, archaeological monitoring was conducted in conjunction with RI activities. Archaeological investigations examined stratigraphic evidence and artifact remains at five sonic drill holes and 12 direct push soil borings. During the Focused Field Sampling conducted in April 2006, archeological monitoring was performed as the direct push soil borings were advanced and sampled. Appendix C includes the trip report from this monitoring. Remnants of stone walls were identified along the south bank of the Morris Canal and the canal towpath. The Morris Canal and associated landscape and architectural features are listed on the National Register of Historical Places (NRHP). Canal walls were encountered during sonic drilling, suggesting that many additional canal architectural features are preserved under modern roadways and parkland. No architectural features were identified outside of the Morris Canal. However, industrial fill consisting of coal cinders, ash, and iron slag was identified in the area of the M. Hoagland Union Foundry and Machine Company, a site potentially eligible for the NRHP.

Due to archeological and historic architectural sensitivity at the Site, additional archeological monitoring is recommended within the Site during future intrusive activities.

1.2.3.5 Habitats (Wetlands, Terrestrial, and Aquatic)

The United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Dover, New Jersey quadrangle (1976) and the NJDEP southeast Dover Freshwater Wetlands Map (1988) were reviewed to determine if wetlands or open water habitats occur on or in the vicinity of the Site. Based upon this review, wetlands or open water habitats do not occur within the Site boundaries. However, a palustrine forested (PFO)/scrub shrub (PSS) complex and a PFO wetland were mapped contiguous to the Site's southeastern and northwestern boundaries, respectively. The PFO/PSS complex, identified on the NWI Dover, NJ quadrangle, is associated with the Rockaway River and is connected to a PFO wetland area located to the northeast. PFO wetlands are also present approximately 750 feet downstream of the Site, on the eastern and western banks of the Rockaway River. The PFO wetland adjacent to the northwestern portion of the Site was identified on the NJDEP SE Dover, NJ wetlands map, and is associated with the outfall from Fox's Pond, located 0.5 mile northwest of the Site. The Rockaway River

flows within 50 feet of the southeastern edge of the Site and is identified as perennial open water (R2OW). A modified wetland (MODD) represented by an area of disturbed soils was also identified on the NJDEP SE Dover, NJ wetlands map as occurring on the southeastern bank of the Rockaway River outside of the Site perimeter.

Most of the Site is comprised of developed lands (*i.e.*, buildings and pavement), which afford very limited natural resource value to support ecological receptors. Small fragmented areas of broad-leaved deciduous forests bordering maintained fields and manicured lawns of residential and commercial properties do occur throughout the Site. These manicured lawns, landscaped islands, and opportunistic growths are located in a developed, heavily trafficked area reducing the appeal for use by higher trophic level ecological receptors.

An unnamed tributary, formed by the outlet of Fox's Pond, is located adjacent to the western portion of the Site. The unnamed tributary flows south from Fox's Pond toward the Rockaway River, located approximately 750 feet south of the center of the Site. It is approximately 50 to 60 feet wide with variable depths and a visible bottom. Litter and evidence of recreational fishing is present along the banks of the river. The Rockaway River and the unnamed tributary have a surface water quality standard of freshwater, non-trout (FW2-NT). The Rockaway River supports a warm-water fishery and supports a seasonal trout stocked fishery.

1.2.3.6 Wildlife

A request for information regarding the presence of threatened and endangered species was submitted to the NJDEP, Natural Heritage Program, and the USFWS. According to the USFWS records, federally-listed species do not occur on or within the vicinity of the Site, except for an occasional transient bald eagle (*Haliaeetus Leucocephalus*). Based on correspondence provided by the NJDEP, rare plant species or rare natural communities do not occur on or within one mile of the Site. Rare wildlife species were also not identified on the Site; however, 11 state-listed threatened or endangered species are recorded as occurring within one mile of the Site. These species include the state-listed threatened barred owl (*Strix varia*), Cooper's hawk (*Accipiter cooperii*), longtail salamander (*Eurycea longicauda longicauda*), red-headed woodpecker (*Melanerpes erythrocephalus*) and wood turtle (*Clemmys insculpta*); and the state-listed endangered Allegheny woodrat (*Neotoma magister*), bobcat (*Lynx rufus*), northern goshawk (*Accipiter gentilis*) and timber rattlesnake (*Crotalus horridus horridus*). The federal and state-listed endangered Indiana bat (*Myotis sodalis*) and the state-listed endangered/threatened (breeding population/migratory or winter population) red-shouldered hawk (*Buteo lineatus*) were also identified.

1.2.3.7 Geology

Rockaway Borough is located within the New Jersey Highlands section of the New England physiographic province, also known as the Reading Prong through New York, New Jersey, and Pennsylvania. The Highlands are a 15- to 20-mile wide band, which trends northeastward, as do its topographic ridges and valleys and geologic formations (Drake *et al.*, 1996).

Glacial deposits and fill material overlie bedrock throughout most of the region. The thickness of these deposits varies and is typically thickest in the bedrock troughs. In Rockaway Borough, glacial deposits may vary in thickness from nonexistent (in bedrock outcrop areas) to over 200 feet thick in valley bottoms. The glacial deposits are comprised of sand, gravel, lacustrine silt and clay, and till (generally tight gravel, sand, silt, and clay mix).

The Soil Survey of Morris County, New Jersey identifies the soils in the vicinity of the Site as part of the Rockaway-Hibernia-Urban land association (RHU). These soils consist of well drained to somewhat poorly drained, gently sloping to steep gravelly sandy loams and stony to extremely stony loams and

sandy loams that overlie granite gneiss. There are three soil series that are of interest to the Site: Urban land soils, Rockaway series soils, and Preakness series soils. Most of the Site is situated on the Urban land series. These areas consist of land that has been cut, filled, smoothed, or mixed during construction. Most areas are paved or built upon. Soils in the remaining open spaces have been reworked to the point that the original profile cannot be recognized. The majority of the Site is situated on the UrC. This mapping unit consists of well-drained, gently sloping or sloping gravelly sandy loam soils. It is mainly in upland areas of intensive residential or industrial development. Slopes range from 0 to 15 percent. The soil material is cobbly and stony glacial till that is mainly granitic gneiss. This mapping unit is typically deep over a water table, has rapid runoff and a moderate hazard of erosion.

Bedrock within the area consists primarily of early Pre-Cambrian metamorphic (crystalline) rocks including: interlayered hornblende, granite, alaskite, quartz-feldspar gneiss, biotite gneiss, pyroxene syenite, quartz diorite, and minor amphibolite and granite pegmatite (ICF, 1991). Moving across strike from southeast to northwest through Rockaway Borough, rock type varies from diorite to gneiss to granite to hornblende-granite (Drake *et al.*, 1996).

Within the Site, unconsolidated deposits were encountered to the maximum depth drilled, approximately 50 feet bgs. The observed unconsolidated deposits can be divided into two basic units, fill and native soil, and were generally dry; the water table was encountered at approximately 38 to 40 feet bgs. Fill comprised primarily of sand, gravel, cobbles, and boulders, with slag, cinders, coal, ash, metal, glass, brick, and shells ranged from 2 to 12 feet bgs. Native soils consisting of brown sand with varying amounts of gravel, silt, cobbles, and boulders were encountered from the bottom of the fill to approximately 50 feet bgs, the maximum depth drilled. Typically, clay and silt comprised approximately 15 percent or less of the soil and gravel comprised approximately 5 to 35 percent of the soil. The native material was typically dry to moist.

1.2.3.8 Hydrogeology

The Morris County area is underlain by two aquifers or water-bearing units. Of the unconsolidated deposits, the glaciofluvial deposits are a major water supply for municipalities (e.g., Rockaway Borough). The bedrock fractures are primarily a source for local domestic supplies and in some cases municipal supplies.

Glaciofluvial aquifers provide the predominant groundwater supply to the region. Recharge to these aquifers occurs in the form of precipitation, infiltration through glaciofluvial deposits, and runoff from bedrock ridges to the upland outcrop areas of the glacial sediments. The highest yielding zones, in which municipal wells are screened, tend to occur in the more gravelly channels in the deeper portions of the deposits (ICF, 1991). Of 127 public supply wells completed in glaciofluvial deposits, yields ranged from 20 to 2,200 gallons per minute (gpm), averaging 502 gpm (Gill and Vecchioli, 1965). The transmissivity of these aquifers averaged high (*i.e.*, 135,000 gpd/ft), based upon 13 pumping tests in Morris County, primarily in the Chatham, Florham Park, Morris Plains, and Wharton areas. An average storage coefficient of 3.9×10^{-4} indicates semi-confined to confined conditions, likely resulting from overlying finer deposits of the terminal moraine and other finer-grained units (Gill and Vecchioli, 1965). The glaciofluvial aquifer is unconfined throughout most of the study area (ICF, 1991).

The high-yielding glaciofluvial aquifer has been developed as a source of potable water by both Rockaway Borough and Township. Recent data from the Rockaway Borough wells show usage of 1,250,000 gallons per day (gpd) in January 2004 (640,000 gpd, 290,000 gpd and 320,000 gpd, respectively, from municipal wells No. 6, No. 5 and No. 1). A higher summer usage example in July 2003, showed an average total of 1,370,000 gpd (760,000 gpd, 300,000 gpd and 310,000 gpd,

respectively, from municipal wells No. 6, No. 5 and No. 1). These wells are all screened in glaciofluvial deposits (Rossi, 2004).

Based upon a Morris County groundwater supply study (Gill and Vecchioli, 1965), 79 large-diameter wells completed in the crystalline bedrock formations yielded between 4 gpm and 400 gpm, averaging between 50 and 75 gpm. Suitable yields generally occur at depths shallower than 300 feet (Gill and Vecchioli, 1965). Transmissivities are estimated at 2,000 to 3,000 gpd/ft (*i.e.*, fairly low) for municipal wells in these formations with storage coefficients of 0.001 that would indicate semi-confined conditions.

Groundwater flow in Rockaway Borough is generally from the uplands toward the Rockaway River (*i.e.*, a general east-southeastward direction). However, with pumping of municipal wells No. 6, No. 5 and/or No. 1, groundwater flow is reversed from the river toward the pumping wells. This reversal induces inflow from the river through the aquifer toward the wells (ICF, 1991).

1.3 Remedial Investigation and Focused Field Sampling Summary

The Site Reconnaissance portion of the RI was performed between 21 June 2003 and 2 January 2004. This task included surveying site areas for buried materials and possible source areas using geophysical techniques. The Site Reconnaissance overlapped with the Field Investigation because some of the Site survey activities were performed following installation of soil borings installed as part of the Field Investigation. The Field Investigation was performed 28 October 2003 through 19 November 2003. During this task sampling of soil gas (73 samples), shallow soils (19 samples), and subsurface soils (48 samples) was performed to delineate the nature and extent of potential soil contamination. In addition, six soil cores were collected to evaluate geotechnical parameters.

In April 2006, a Focused Field Sampling program was conducted to refine the characterization of PCE detected in soil in the vicinity of RI soil boring D4 (located in the Wholly Scrap! parking lot). The Focused Field Sampling consisted of installing ten soil borings using direct push techniques. Two soil samples were collected from each of the ten soil borings and were submitted for CLP analyses for TCL VOC and 1,4-dioxane. The results of the Focused Field Sampling (see Table 1-1 and Figure 1-3) confirmed that the PCE detected in RI soil boring D4 was limited in horizontal and vertical extent.

1.3.1 Nature and Extent of Contamination

The nature and extent of soil contamination present at the Wall Street/East Main Street Site was determined based on the results of the Site Reconnaissance, Field Investigation, and Focused Field Sampling, which included soil sampling. In addition, an evaluation of available historical information and the results of the geophysical and soil gas surveys completed during the Site Reconnaissance was performed to assist in the determination of potential contaminant source areas.

Criteria used to assist in the interpretation of the nature and extent of surface and subsurface soil contamination at the Site included Applicable or Relevant and Appropriate Requirements (ARARs) (*i.e.*, standards promulgated under federal or state law) and "to be considered" (TBC) guidance values, which are not promulgated. When there was more than one criterion value for a specific constituent, the most conservative screening value (*i.e.*, the lowest) was utilized during the comparison.

Volatile Organics: PCE is the primary contaminant at the Wall Street/East Main Street Site and is present at elevated concentrations in the soil (*i.e.*, up to 14,000 µg/kg in the surface and 730 µg/kg in the subsurface), specifically in the vicinity of Lusardi's Cleaners, the southeastern portion of Municipal Parking Lot #2, and the parking lot northwest of Wholly Scrap! and northeast of Lusardi's Cleaners. Figure 1-3 illustrates the estimated horizontal extent of PCE in surface soil. Figure 1-4 illustrates the

concentrations of PCE detected in soil gas at the Site. Other volatile organics identified during the RI included benzene (90 µg/kg) and methylene chloride (68 µg/kg).

Inorganics: Metals (*i.e.*, chromium, lead, and nickel) were detected throughout the soil columns. The concentrations of chromium detected in surface soil ranged from 11.3 mg/kg to 130 mg/kg. The concentrations of lead in surface soil ranged from 18.5 mg/kg to 697 mg/kg. The concentrations of nickel detected in surface soil ranged from 9.9 mg/kg to 38.3 mg/kg. The concentrations of hexavalent chromium detected in surface soil ranged from 0.25 mg/kg to 0.45 mg/kg. The concentrations of chromium detected in subsurface soil ranged from 9.3 mg/kg to 23.6 mg/kg. The concentrations of lead detected in subsurface soil ranged from 0.2 mg/kg to 2.1 mg/kg. The concentrations of nickel in subsurface soil ranged from 5.0 mg/kg to 9.9 mg/kg. Hexavalent chromium was not detected in subsurface soil. It should be noted that the more elevated concentrations of inorganics occurred in the general area that contained elevated amounts of PCE. However, based on the risk assessment results, these inorganics were not retained as contaminants of concern (see Section 1.3.3).

1.3.2 Contaminant Fate and Transport

The primary fate and transport mechanisms affecting halogenated and non-halogenated VOCs detected at the Site are volatilization into the air and migration in groundwater. Certain conditions restrict or eliminate these compounds' contact with the atmosphere, such as overlying asphalt or concrete, minimizing volatilization into the air. The majority of the locations where VOCs were detected during the RI are below asphalt paving.

The inorganics detected during the RI are persistent and of limited mobility within environmental matrices under normal environmental conditions. A large portion of the Site is paved with asphalt, a relatively impervious surface cover, which minimizes the potential for leaching to groundwater and prevents runoff from contacting soil.

Based on the evaluation of the potential migration pathways for the VOCs and metals detected in soils, the following migration pathways were considered most relevant in the RI:

- The migration of contaminants to underlying subsurface soils and eventually to groundwater by the percolation of rainwater through contaminated soils;
- The potential migration of contaminants into air via the entrainment of contaminated soil particles by the wind (*i.e.*, fugitive dust emissions principally for metals) and volatilization (primarily for organic compounds into building basements/structures); and
- Migration of contaminants from potential source areas to environmental media via wind resuspension and dispersion, volatiles diffusion and dispersion, erosion/runoff, and/or infiltration and leaching.

The RI soil data indicate that several volatile organics (*e.g.*, PCE and methylene chloride) have migrated in subsurface soil. The historical groundwater data show that on-site migration of site-related contaminants through soil via percolating rainwater into groundwater is especially important for PCE, although this mechanism is applicable to other volatile organics (*e.g.*, TCE, 1,1-dichloroethane, cis-1,2-dichloroethene, etc.) and a limited number of metals as well.

Although volatile emissions directly into the atmosphere from on-site soils, with their accompanying migration via the prevailing wind, would be a viable transport mechanism for some areas (primarily any non-paved/covered bare soil or grassy areas adjacent to Lusardi's Cleaners and/or behind Wholly Scrap!). Considering the expansive development and grass covering most of the Site, the emission of volatile compounds into the atmosphere is expected to be extremely limited and favored only in a limited number

of discrete on-site locales including: the Lusardi's Cleaners, Inc. and Wholly Scrap! properties. However, the majority of these properties are covered by structures and overlain by asphalt.

It should be noted that the migration of contaminants to and within transitory impounded surface water and surface runoff either directly or via the stormwater drainage system and eventually to the Rockaway River is a viable environmental fate and transport mechanism at the Site. Based on review of aerial photographs, this mechanism was more prevalent historically due to the less developed nature of the Site. Today, the asphalt and concrete surface cover as well as the buildings limit the ability of surface water to contact surface soils. However, there are no data to further define or substantiate the actual role of this mechanism at the Site.

1.3.3 Human Health Risk Assessment

A Baseline Human Health Risk Assessment (BHHRA) was prepared in accordance with the Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-01D-1 entitled, "*Risk Assessment Guidance for Superfund (RAGS) Part D*" (EPA, 2001) and other RAGS guidance. A Pathways Analysis Report (PAR) dated 26 April 2004 (TtFW, 2004) was completed by Tetra Tech prior to completing the BHHRA. The BHHRA examined the potential exposures of current and possible future receptors to the Site soils in accordance with the Conceptual Site Model (CSM) developed for the Site. Four areas of the Site were considered for evaluation based on current and future receptors: Lusardi's Basement, Lusardi's Backyard, Memorial Park, and the Former Foundry Property.

Lead was selected as a Chemical of Potential Concern (COPC) in one area (Lusardi's Backyard) for surface soil and all soil (*i.e.*, surface and subsurface soil). PCE was selected as a COPC in Lusardi's backyard and the Former Foundry Property surface and all soil. The exposure pathways and receptors identified for the Site and addressed in the BHHRA were as follows:

- Exposure to the surface soils from the parking lot immediately north of Lusardi's and the rear lawn of the property east of Lusardi's (hereafter collectively referred to as "Lusardi's Backyard Area") via incidental ingestion, dermal absorption, particulate inhalation, and volatile compound inhalation (*i.e.*, drycleaning worker and construction worker);
- Exposure to the indoor air at buildings on the Former Foundry Property via volatile compound inhalation (*i.e.*, commercial worker and residents living in the second floor apartments above nearby businesses); and
- Exposure to all soils from Lusardi's Backyard and the Former Foundry Property via incidental ingestion, dermal adsorption, particulate inhalation, and volatile compound inhalation (*i.e.*, construction worker).

Potential exposure pathways associated with the other identified receptors in the CSM were not addressed in the BHHRA either because no COPCs were identified for a particular exposure area or because the exposure parameters (*i.e.*, exposure duration or exposure frequency) for that receptor were determined to be less than those for another receptor that was being evaluated.

Projected Reasonable Maximum Exposure (RME) and Central Tendency (CT) risks for the dry cleaning worker potentially exposed to surface soil in Lusardi's Backyard and for the construction worker potentially exposed to all soils in Lusardi's Backyard and the Former Foundry Property were calculated to be less than or within EPA's range of acceptable cancer risks and below the EPA Hazard Index (HI) benchmark.

The BHHRA also addressed the potential contributions to risk from a vapor migration to indoor air pathway by conducting a screening risk assessment using the soil gas samples collected during the Site

Reconnaissance. The results of the screening assessment of the potential soil gas-to-indoor air pathway revealed that the shallow and deep soil gas samples collected in Lusardi's Basement and Lusardi's Backyard as well as the shallow soil gas samples collected on the Former Foundry Property exceeded their respective screening values. According to the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater to Soil* (EPA, 2002), a more detailed site-specific evaluation is warranted due to these exceedances, as long as there is a potential for a routinely occupiable structure to be located at the Site. EPA is currently conducting indoor air sampling in Rockaway Borough.

1.3.4 Ecological Risk Assessment

A Screening Level Ecological Risk Assessment (SLERA) was performed for the on-site surface soils at the Site. Chromium, hexavalent chromium, lead, and nickel were detected in two of the sampling locations in surface soils with complete exposure pathways and potential ecological receptors. Although these metal concentrations exceeded their respective screening criteria (*i.e.*, 21 mg/kg, 0.40 mg/kg, 40.5 mg/kg, and 30 mg/kg, respectively), the detected concentrations do not appear to represent an excessive exposure relative to ambient background concentrations. In addition, the limited amount of open space and the high volume of pedestrian and automobile traffic restrict the usability of these areas by wildlife species. Since the observed concentrations of inorganics are comparable to background concentrations and there is minimal terrestrial habitat, there are low risks to ecological receptors. Based on these findings, continuation of the ecological risk assessment process through performance of a Baseline Ecological Risk Assessment was not recommended.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Introduction

The purpose of this section is to present the development of Remedial Action Objectives (RAOs) as well as the identification, screening, and selection of the most appropriate technologies to address contaminated soil at the Site. The most appropriate technologies and process options will be combined into remedial alternatives and screened in Section 4.0.

The identification and screening of technologies consisted of the following steps:

- Establishment of Remedial Action Objectives (RAOs) – RAOs specify the contaminants and media of concern (*i.e.*, contaminated soils), exposure routes and receptors, and Preliminary Remediation Goals (PRGs) that permit a range of treatment and containment alternatives to be developed. The PRGs were developed based on ARARs or TBCs and the risk assessment findings.
- Establishment of General Response Actions (GRAs) – The GRAs for soil include No Action, Institutional Controls (*e.g.*, use restrictions, etc.), Containment, Treatment, and Disposal activities which can be implemented, singly or in combination, to satisfy the RAOs. The GRAs take into consideration the requirements for protectiveness identified in the RAOs, as well as the physical and chemical characteristics of the Site.
- Identification and Screening of Applicable Remedial Technologies – For each of the GRAs developed for contaminated soil, remedial technologies/process options were identified and screened to select those technologies/process options that are applicable to the conditions and contaminants present at the Site. The screening is based primarily on the effectiveness of the technology/process option to address the contaminants of concern. However, implementability and costs are also factored into the screening. Although a number of process options for a given technology type may be retained during the screening, a single process option considered representative of the technology type has been identified for alternative development. Treatability study needs for those technologies that are probable candidates for consideration during the detailed analysis are also identified during the screening of technologies.

2.2 Remedial Action Objectives

RAOs are identified to protect human health and the environment and are based on consideration of the Chemicals of Concern (COCs), exposure routes, receptors, and acceptable contaminant levels (*i.e.*, PRGs) for each exposure pathway.

2.2.1 Chemicals of Concern

As discussed in the RI Report for soils (TtFW, 2005a), PCE, benzene, methylene chloride, chromium and lead were detected at the Site above the screening criteria. Based on validity of the analytical results, frequency of occurrence, toxicological, physical, and chemical characteristics, the BHHRA identified only PCE as a COC. According to the SLERA, contaminant concentrations do not represent an excessive exposure relative to background concentrations. No COCs were identified with respect to ecological receptors.

2.2.2 Exposure Pathways Based on Risk Assessment

The BHHRA examined potential exposures for current and possible future receptors to site soils in accordance with the CSM developed for the Site. To evaluate potential human health risks, the following exposure pathways were identified and evaluated:

- Incidental ingestion, dermal absorption, particulate inhalation, and volatile compound inhalation of surface soils from Lusardi's Backyard by the dry cleaning worker and/or the construction worker.
- Inhalation of indoor air in buildings on the Former Foundry Property by the commercial worker and/or resident living in the second floor apartments above nearby businesses.
- Ingestion, dermal absorption, particulate inhalation, and volatile compound inhalation of all soils (i.e., surface and subsurface) from Lusardi's Backyard and the Former Foundry Property by the construction worker.

Projected RME and CT risks for the dry cleaning worker potentially exposed to surface soil in Lusardi's Backyard and for the construction worker potentially exposed to all soil in Lusardi's Backyard and the Former Foundry Property were calculated to be within the EPA's range of acceptable cancer risks, and below the EPA HI benchmark. The BHHRA indicated the potential risk from the inhalation of indoor air would require a more detailed evaluation, if routinely occupied buildings are located at the Site.

2.2.3 ARARs and TBCs

EPA developed the ARAR concept under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) to govern compliance with environmental and public health statutes. ARARs are used in the FS process to characterize the performance level that a remedial alternative or treatment process is capable of achieving. Each remedial alternative and treatment process option must be assessed to evaluate whether it attains or exceeds federal and state ARARs.

ARARs include "applicable" and "relevant and appropriate" requirements of federal and state environmental laws. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular Site. When establishing performance goals for remedial alternative selection, relevant and appropriate requirements are given equal weight and consideration as applicable requirements. State requirements are ARARs when promulgated, identified in a timely manner and at least as strict as existing equivalent federal ARARs. Section 121 of CERCLA requires that EPA select remedial actions that will comply with ARARs, unless the criteria for a waiver are met, as discussed below, and EPA waives one or more ARARs.

If no ARARs address a particular situation, other federal and state criteria, advisories, guidance, or proposed rules may be considered for developing remedial alternative performance goals. These "to be considered" materials (TBCs) may provide useful information or recommended procedures that supplement, explain, or amplify the content of ARARs.

Each type of ARAR/TBC can be characterized further as chemical-specific, location-specific, or action-specific. A chemical-specific ARAR/TBC sets health and risk-based concentration limits in various environmental media for specific hazardous substances or contaminants. A location-specific ARAR/TBC sets restrictions for conducting activities in particular locations, such as wetlands, floodplains, natural historic districts, and others. An action-specific ARAR/TBC sets performance, design, or other similar action-specific controls on particular remedial activities. The federal and New Jersey ARARs and TBCs identified for the Site are presented in Tables 2-1 through 2-3.

Under Section 121 of CERCLA, EPA may waive the need to attain an ARAR if one of the following conditions can be demonstrated:

- Selection of Interim Remedy – the remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control when completed;
- Greater Risk to Human Health and Environment – compliance with the ARAR at the Site will result in greater risk to human health and the environment than the alternative option chosen;
- Technical Impracticability – compliance with the requirement is technically impracticable from an engineering perspective;
- Equivalent Standard of Performance Attained – the remedial action selected will attain a standard of performance that is equivalent to that required under the ARAR through use of another method or approach;
- Inconsistent Application of State Requirement Would Result – the state has not consistently applied, or demonstrated intention to apply consistently, the ARAR in similar circumstances at other Sites; or
- Fund Balancing – attainment of the ARAR would not provide a balance between the need for protection of public health or welfare and the environment and availability of fund amounts to respond to other sites presenting a threat to the public or environment, for fund financed cleanups only.

2.2.4 Identification of Remedial Action Objectives

- The RAO developed for the Site is to mitigate the migration of PCE from soil to groundwater.
- The NJDEP Impact to Groundwater Soil Cleanup Criteria (IGWSCC) of 1,000 µg/kg for PCE has been identified as the cleanup goal to achieve this objective.

2.3 General Response Actions

The following GRAs for soil were identified to address the RAO presented above: No Action, Limited Action, Institutional Controls (e.g., use restrictions, etc.), Containment, Removal, and Treatment activities.

- No Action includes no monitoring, containment, or removal of contaminated soil. A No Action Alternative is required under CERCLA as a baseline for comparison of alternatives.
- Limited Action includes monitoring, public information programs to educate the community about potential hazards, and access and use restrictions for the contaminated soils. Continued monitoring of the soils over time would facilitate determination of natural restoration rates.

- Containment includes technologies that involve little or no treatment, but provide protection of human health and the environment by reducing mobility of contaminants and/or eliminating exposure pathways.
- Removal/Treatment includes soil excavation and treatment technologies that actively reduce the volume, mobility, and/or toxicity of contaminants. Treatment technologies include physical, chemical, biological, thermal, or *in situ* types.

2.4 Identification and Screening of Technologies and Process Options

The screening of remedial technologies and process options was performed in two steps. First, technology types and process options within each of the GRAs were identified and screened. Second, representative process options were evaluated and selected for alternative development.

2.4.1 Identification and Screening of Technologies

The remedial technology types associated with each of the GRAs typically considered for the cleanup of contaminated soils were developed from the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988), the "Revised Handbook for Remedial Action at Waste Disposal Sites" (EPA, 1985), experience on other projects involving contaminated soil, and vendor information. Remedial technology types associated with each GRA are identified in Table 2-4. Most of these remedial technology types contain several different process options that could apply to the contaminated soils; process options associated with each technology type are also identified in Table 2-4.

The technology types and process options were screened based on technical implementability. The screening of technologies and process options eliminates those technologies and/or process options that cannot be effectively implemented at the Site due to site conditions and/or contaminants of concern. The screening of technologies and process options is presented in Table 2-5. As a result of this screening, several remedial technology types were eliminated from further consideration based on the technical infeasibility of performing such actions. Process options retained for evaluation include no action, inform public and hold local meetings, implement institutional controls, clay cap, asphalt cap, excavation, *in situ* oxidation, *in situ* solidification/solidification, *in situ* hot air/steam, *in situ* soil vapor extraction, off-site disposal, and reuse/recycling.

2.4.1.1 Screening of Soil Remediation Technologies

In the following section, potential remedial technologies are briefly described and summarized with the results of the initial screening. For those technologies that were not retained for further evaluation, the rationale for their elimination is included. The screening evaluations for each identified technology for contaminated soil are summarized in Table 2-6.

2.4.1.1.1 No Action

No Action is not a category of technologies but an approach that does not include implementation of any remedial measures and is included in the FS as a baseline remedial option as required by CERCLA. No Action includes five-year reviews of site conditions to assess the need for future remedial actions.

Initial Screening: No Action would leave contaminated soils in place with no treatment or controls to prevent migration of PCE to groundwater or indoor air. Natural attenuation would be an insignificant contributor to any reduction in contaminant toxicity, mobility, or volume. The No Action Alternative would not limit community exposure to the contaminants. Although No Action would not meet the remedial objectives, it is retained for further consideration as a baseline for comparison of other alternatives.

2.4.1.1.2 Limited Action

Limited Action is a group of activities, which would not treat the contaminants in the soil but would restrict or minimize public exposure to contaminants. The Limited Action response would require the establishment of institutional controls.

Institutional Controls

Institutional controls include administrative measures, such as public meetings, notifications and deed notices or restrictions, to inform the public about potential risks associated with the contamination, and to prohibit future unrestricted use inconsistent with site conditions. Additionally, it would require intermittent site reviews and the implementation of a Health and Safety Plan (HASP). It would be necessary to obtain the property owner's consent prior to imposing use restrictions on the property.

Initial Screening: Institutional controls would not meet the remedial objective, but would potentially reduce public exposure to contaminated soil through public information programs and/or use restrictions placed on the property. Implementation of a HASP would establish procedures to reduce worker exposure to soil through physical contact or inhalation of dust during future activities. Institutional controls are therefore retained for further consideration.

2.4.1.1.3 Containment

Containment is a remedial action providing isolation of contaminated soil from potential receptors and/or uncontaminated media. Capping technologies can be used to contain contaminated soil, minimize human exposure to soil, reduce leaching of contaminants from the soil to groundwater, and/or minimize exposure of ecological receptors. Capping of contaminated soil could be achieved by utilizing soil caps, clay caps, asphalt caps, or multimedia caps. Additionally, any "hardscape" surfaces (e.g., building foundations, concrete walkways, asphalt parking areas, etc.) could be used in conjunction with the capping methods that follow.

Soil Cap

Installing a soil cap over contaminated soil would prevent direct contact with contaminants. However, a soil cap has high permeability relative to clay, and would allow percolation of surface water, runoff, etc.

Initial Screening: Soil caps are susceptible to erosion from climatic and storm forces, which can be mitigated with a properly maintained vegetative cover. Soil caps are also susceptible to settling, ponding of liquids, and naturally occurring invasions by burrowing animals and deep rooted vegetation if not properly maintained. A soil cap would not mitigate migration of PCE to groundwater. Therefore, this option was not retained for further consideration.

Clay Cap

Clay caps are commonly used as cover for lands that contain both hazardous and nonhazardous wastes. Bentonite, a natural clay with high swelling properties, is often mixed with soil and water to produce a low permeability layer. A low permeability clay cap would not only physically isolate the source, but also reduce the potential for leaching of contaminants to groundwater by creating a low permeability barrier.

Initial Screening: Clay, which consists of fine material, is susceptible to erosion from climatic and storm forces which can be mitigated with a properly maintained vegetative cover. Proper particle distribution is

essential to create a low permeability cap. Clay caps are also susceptible to cracking, settling, ponding of liquids, and naturally occurring invasions by burrowing animals and deep rooted vegetation if not properly maintained. However, the low permeability of a clay cap would be effective for reducing infiltration of stormwater that facilitates the migration of PCE into the groundwater. This option was retained for further consideration.

Asphalt Cap

An asphalt cap would consist of a gravel sub-base with asphalt paving as a final cover. The cap minimizes wind and rain erosion, preserves slope stability, provides protection from the elements for layers below it, provides an effective component for the Site's stormwater management program, also reduces the potential for leaching of contaminants to groundwater by creating a low permeability barrier.

Initial Screening: An asphalt cap provides a low permeability cover to contain contaminated areas. It is less susceptible to erosion from climatic and storm forces than a soil or clay cap. An asphalt cap is subject to cracking and settling if not properly maintained. However, it is highly effective in reducing direct contact with contaminated soils and reducing infiltration of stormwater that facilitates the migration of PCE into the groundwater. This option was retained for further consideration.

Multimedia Cap

The multimedia cap is a combination of two or more of the single layer capping technologies. The disadvantage of one can be compensated by the advantage of another. Most caps recommended for hazardous waste projects are multimedia caps such as a three-layered system. Contaminated soil is covered with a composite cap consisting of a vegetative layer, a drainage layer, and a low permeability layer.

Initial Screening: The performance of a properly installed, multimedia cap is generally excellent. However, over time, the integrity of the low permeability synthetic layer becomes uncertain and should be investigated regularly. However, installation of a multimedia cap is not feasible since the contaminated area is relatively small and the Site is located in a developed area. Therefore, this option was not retained for further consideration.

2.4.1.1.4 Removal

This process involves the excavation of contaminated soils. This category employs typical construction equipment such as backhoes, bulldozers, front-end loaders, and draglines. Excavation is a preliminary or support technology and is often utilized in conjunction with other remedial actions, which first require removal of the contaminated soil. Subsequent actions include additional treatment and/or disposal.

Initial Screening: Excavation is required as the initial materials handling step in other remedial actions. One or more types of excavation equipment would be used in the excavation of contaminated soil for final treatment and/or disposal. The services, materials, and equipment required for removal are well developed and readily available. Removal is therefore retained for further consideration.

2.4.1.1.5 Treatment

Treatment technologies are utilized to change the physical or chemical state of a contaminant, destroy the contaminant completely, or reduce contaminant toxicity, mobility, or volume.

Physical Treatment

Physical treatment is a category of technologies which utilize changes in physical properties of contaminants to reduce their toxicity, mobility or volume. This category of technologies includes solidification/stabilization and soil washing.

Solidification/Stabilization

Stabilization is a process whereby contaminated soils are converted into a stable cement type matrix in which contaminants are bound or trapped and become immobile. Silicates can stabilize contaminants such as metals and some organics in soil. It has been demonstrated that chemical fixation products of certain silicate-base mixtures can meet the hazardous waste Toxicity Characteristic Leaching Procedure (TCLP) tests.

Initial Screening: This process would be effective for the contaminated soil. This technology would immobilize contaminants in the soil matrix and would require long-term monitoring at the point of disposal. Stabilization can be done either by on-site mobile units or at off-site commercial facilities. Although the technology is proven and commonplace, bench testing is required to identify the site-specific appropriate (cementitious) additives and dosage rates, particularly for VOCs. The small quantity of soil and limited space available for on-site treatment make this technology not feasible. This technology was not retained for further evaluation.

Soil Washing

Soil washing is a separation process whereby contaminants sorbed onto the fines portion of soil are separated in a water-based system from the containing medium. The water wash may be augmented with a leaching agent, surfactant, pH adjustment, or a chelating agent to help in removal. The process separates contaminants from soil in one of two ways: 1) by dissolving/suspending contaminants in the wash solution, or 2) by concentrating the contaminants into a smaller volume of soil through screening, gravity separation, and attrition scrubbing.

Initial Screening: Soil washing is considered a media transfer technology. Significant feedstock preparation is necessary and large volumes of contaminated water are generated during the process. The contaminated water from the separation process requires additional treatment by the appropriate technology(s) for the contaminants of concern. The treated silt and clay fraction may potentially be disposed off-site without further treatment at a non-hazardous landfill or may be re-used in conjunction with a non-hazardous capping system. This technology has limited effectiveness for the contaminants of concern, specifically PCE, due to its low solubility. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible and it was therefore eliminated from further evaluation.

Chemical Treatment

Chemical treatment is a category of technologies which utilize chemical reactions to reduce the toxicity, mobility or volume of contaminants. This category of technologies includes lime neutralization, chemical oxidation, chemical dehalogenation, and chemical / solvent extraction.

Lime Neutralization

Lime addition to contaminated soil neutralizes acids in the soil by raising the pH.

Initial Screening: Lime neutralization is not applicable for PCE. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. This technology is therefore eliminated from further evaluation.

Chemical Oxidation

An oxidizing agent, such as hydrogen peroxide, reacts with the soil and breaks down the organic constituents into carbon dioxide and water.

Initial Screening: Bench-scale testing and field pilot studies are necessary to determine the operational conditions for this type of remediation. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. This technology is therefore eliminated from further evaluation.

Chemical Dehalogenation

In dehalogenation, chemical reagents are added to soils contaminated with halogenated (chlorinated) organics in a heated slurry of reagents and soil. Dehalogenation is achieved by either the replacement of the halogen molecules or the decomposition and partial volatilization of the contaminants.

Initial Screening: The target contaminant groups for dehalogenation are halogenated SVOCs and pesticides and dehalogenation is less effective against halogenated VOCs. The process design must assure sufficient contact to be effective. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, dehalogenation was not retained for further consideration.

Chemical/Solvent Extraction

Chemical extraction is a separation process which does not destroy the waste in soils, but instead separates them from the medium. This separation process decreases the volume of waste that must be additionally treated or disposed. In chemical extraction, waste-contaminated soil and an extractant are mixed in an extractor, thereby dissolving the contaminants. The extracted solution is then placed in a separator, where contaminants and extractants are separated for further treatment and re-use, respectively.

Initial Screening: Capital costs for chemical extraction can be relatively high. The process design must assure sufficient contact to be effective. Organically bound metals may be extracted along with target organic pollutants, which restricts handling of the residuals. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology was not retained for further evaluation.

Biological Treatment

Biological treatment is a biochemical process in which organics are broken down to simpler substances by microorganisms. Biological treatment technologies considered are aerobic biodegradation and anaerobic biodegradation.

Aerobic Biodegradation

Organic molecules are oxidized to carbon dioxide (CO₂), water, and other innocuous end products using molecular oxygen as the terminal electron acceptor. Oxygen may also be incorporated into intermediate products of microbial catabolism through the action of oxidizing enzymes, making them more susceptible

to further biodegradation. Typically, aerobic biodegradation processes are used more often than anaerobic processes for biodegradation because the degradation process is more rapid and more complete, and offensive end products (*i.e.*, methane, hydrogen sulfide) are not produced.

Initial Screening: While aerobic biodegradation has been demonstrated to be effective on some non-chlorinated organics such as benzene, toluene, and xylene, it has limited effectiveness in the removal of PCE. Aerobic biodegradation may require several years to achieve cleanup goals. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology is eliminated from further evaluation.

Anaerobic Biodegradation

Organics are broken down to methane, cellular biomass, and intermediate organic compounds via anaerobic respiration (in an oxygen-free environment). This is accomplished by facultative and obligate anaerobes. The strict anaerobes require totally oxygen-free environments and an oxidation/reduction potential of less than -0.2 volt.

Initial Screening: Anaerobic biodegradation can degrade certain halogenated organics, it has limited effectiveness in the removal of PCE. The process may require several years to achieve cleanup goals. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology is eliminated from further evaluation.

Thermal Treatment

Thermal treatment is a technology category which employs thermal energy to treat contaminated media and reduces contaminant volume, toxicity, and mobility. The process options included in this technology category are thermal desorption, incineration and pyrolysis.

Thermal Desorption

The thermal desorption technology is a thermal stripping process. Prepared soils are introduced into the enclosed heated chamber using a heated screw or belt conveyor. Direct or indirect heating methods are used to volatilize organics from the soil. The off-gas containing the thermally stripped compounds is then combusted in an afterburner, adsorbed in a carbon adsorption unit or treated by catalytic oxidation designed to ensure removal of these compounds. Typical operating temperatures for thermal stripping of organics are 400°F to 900°F.

Initial Screening: Thermal desorption treatment costs can be high. Thermal stripping is similar to the primary chamber of incineration technology but operates at lower temperatures. This technology can be performed either by on-site mobile units or at off-site commercial facilities. Desorption is effective at removing organics from the soil, however, metals remain in the impacted material and require additional treatment. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology is eliminated from further evaluation.

Incineration

Incineration is a thermally destructive method used to volatilize and combust (in the presence of oxygen) all forms of combustible waste materials and organic contaminants in soil. Incineration units such as multiple hearth, rotary kiln, infrared incineration, and fluidized bed incineration systems treat organic contaminants at high temperatures (1,200°F to 2,400°F). The destruction and removal efficiency (DRE)

for properly maintained/operated incinerators exceeds the 99.99 percent requirement for RCRA hazardous waste.

Initial Screening: Incineration can be performed either by on-site mobile units or at off-site commercial facilities, however, the costs are very high. Additionally, regulations require permitting, which can be a lengthy and difficult process. High temperature incineration is best suited for the destruction of VOC and SVOC organics, PCBs, dioxins, and pesticides in soil however; metals remain in the impacted material and require additional treatment. Off-gases and combustion residuals generally require treatment. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology is eliminated from further evaluation.

Pyrolysis

Pyrolysis is a chemical decomposition process, which is induced in organic materials by applying heat in the absence of oxygen. Organic materials are transformed into gaseous components and a solid residue (coke) containing fixed carbon and ash. In practice, pyrolysis is operated at less than stoichiometric quantities of oxygen, under pressure, and at operating temperatures above 800°F.

Initial Screening: Pyrolysis systems can be applicable for a number of organic materials that undergo a chemical decomposition in the presence of heat and has shown promise in treating organic contaminants in soils and sludges, but is not feasible for streams with high concentrations of metals or inorganics. This is not a conventional full-scale technology. Additionally, the small quantity of contaminated soil and limited space available for on-site treatment make this technology not feasible. Therefore, this technology is eliminated from further evaluation.

In Situ Treatment

In situ treatment is a technology category in which contaminated soil is treated "in place" without excavation. The *in situ* technologies evaluated in this category are biodegradation, oxidation, solidification/stabilization, vitrification, soil washing, hot air/steam injection, soil vapor extraction (SVE), and phytoremediation.

In Situ Biodegradation

Biological treatment involves the use of native microbes or selectively adapted bacteria to degrade a variety of organic compounds. The biological processes usually involve the addition of microbes, nutrients, and oxygen (aerobic bioreclamation only), as well as the recirculation of contaminated groundwater. The applicability of a bioreclamation approach is determined by the biodegradability of the organic contaminants, and environmental factors affecting microbial activity. *In situ* biodegradation can be either aerobic or anaerobic depending upon the contaminants present on the site.

Initial Screening: *In situ* biodegradation is not a widely employed technology for hazardous waste cleanup which requires extensive bench and pilot-scale testing to verify its effectiveness. While biodegradation has been demonstrated to be effective on some organics, it has limited effectiveness for treatment of PCE. Therefore, *in situ* biodegradation was eliminated from further consideration.

In Situ Oxidation

This technology involves the use of a chemical reagent that is injected into the contaminated media via constructed wells or driven wellpoints to break down the organic constituents into carbon dioxide and

water. The amount of reagent needed, spacing of injection points, and the frequency of addition to achieve cleanup goals are dependent upon organic constituent concentrations.

Initial Screening: This treatment technology can best be applied to contaminated media impacted with high molecular weight organic constituents, although field pilot studies would be necessary to further refine the operational conditions of this technology. This technology is effective for PCE removal and was retained for further evaluation.

In Situ Solidification/Stabilization

In situ solidification/stabilization is a process whereby contaminated soils are converted in-place into a stable cement-type matrix making the contaminants bound or trapped and become immobile. Silicates can stabilize contaminants such as metals and some organics. It has been demonstrated that chemical fixation products of certain silicate-base mixtures do not leach metals and most organics.

Initial Screening: This process would be effective for treatment of the contaminated soil. This technology would immobilize contaminants in the soil matrix, and disposal is not required. It would require long-term monitoring at the facility. Field testing is required to identify the site-specific appropriate additives and dosage rates. Pilot tests may be necessary to determine the effectiveness for treating PCE. This technology was retained for further evaluation as a process option.

In Situ Vitrification

In situ vitrification (ISV) typically uses an electric current to melt soil or other earthen materials at extremely high temperatures (1,600 to 2,000°C or 2,900 to 3,650°F) and thereby immobilize most inorganics and destroy organic pollutants by pyrolysis. Inorganic pollutants are incorporated within the vitrified glass and crystalline mass. Water vapor and organic pyrolysis combustion products are captured in a hood, which draws the contaminants into an off-gas treatment system that removes particulates and other pollutants from the gas. The vitrification product is a chemically stable, leach-resistant glass and crystalline material similar to obsidian or basalt rock. The process destroys and/or removes organic materials. Radionuclides and heavy metals are retained within the molten soil.

Initial Screening: The ISV process can destroy or remove organics and immobilize most inorganics in contaminated soils, sludge, or other earthen materials. The process has been tested on a broad range of VOCs and SVOCs, other organics, and on most priority pollutant metals and radionuclides. However, ISV requires large amounts of power and is typically only used for radiological encapsulation. Therefore, *in situ* vitrification was eliminated from further consideration as a process option.

In Situ Soil Washing

Soil washing is the *in situ* extraction of inorganic or organic compounds from soil by passing appropriate extractant solutions through the soils to dissolve or solubilize contaminants. The area to be treated must be isolated by vertical and horizontal groundwater containment barriers. Water or an aqueous solution is flooded or injected into the area of contamination and the contaminated elutriate is collected at the surface for removal, recirculation, on-site treatment, or reinjection. During elutriation, sorbed contaminants are mobilized into solution by the dissolution process, formation of an emulsion, or by chemical reaction with the flushing solution. These solutions may include water, surfactants, acids or bases, chelating agents, or oxidizing and reducing agents.

Initial Screening: A large volume of wastewater would be generated due to multiple flushing steps to treat the contaminants of concern and would require collection and management via treatment and discharge.

Soil flushing is not amenable to the heterogeneous soil since heterogeneous soil negatively impacts the ability of the washing agent to make contact with contaminants. This technology has limited effectiveness for the contaminants of concern, specifically PCE due to its low solubility. The geology and hydrogeology must be well understood so that control of the process fluids and contaminants are controlled and not spread beyond the site boundaries. Therefore, *in situ* soil washing was eliminated from further consideration as a process option.

In Situ Hot Air/Steam Injection

Hot air or steam is injected below the contaminated zone to heat up contaminated soil. The heating enhances the release of contaminants from the soil matrix. Some VOCs are stripped from the contaminated zone and brought to the surface through soil vapor extraction.

Initial Screening: Debris or other large objects buried in the media can cause operating difficulties. Soil with highly variable permeabilities may result in uneven delivery of gas flow to the contaminated regions. Additionally, soil that is tight or has high moisture content has a reduced permeability to air and will hinder the operation by requiring more energy input to increase vacuum and temperature. This technology is effective for the removal of PCE. However, soils with high organic content typically have a high sorption capacity for VOCs, which results in reduced removal rates. Air emissions may need to be regulated to eliminate possible harm to the public and the environment. This technology was retained for further evaluation.

In Situ Soil Vapor Extraction

A vacuum is drawn through extraction wells to create a pressure/concentration gradient that induces gas-phase volatiles to be removed from soil through extraction wells. This technology also is known as *in situ* soil venting, *in situ* volatilization, enhanced volatilization, or soil vacuum extraction.

Initial Screening: *In situ* SVE remove PCE from the matrix. Because the process involves the continuous flow of air through the soil, it may also promote biodegradation. This technology was retained for further evaluation.

Phytoremediation

Phytoremediation is the use of hybrid plants to extract contaminants from contaminated media. Specially selected plants known to be effective for such purposes are planted and allowed to grow. As the plants grow they absorb contaminants. The plants are then harvested and either incinerated or composted.

For example, the Indian mustard plant has been the subject of much investigation into its potential for extracting contaminants from soil. It has been shown to be effective in absorbing high amounts of lead, copper, and other heavy metals, as well as PAHs, into its stalks and leaves. The roots typically reach about 20 inches into the ground. If the plants are incinerated after harvest, they leave behind an ash that is valuable for its content of metal, which may exceed 40 percent.

Initial Screening: This technology has not been demonstrated for PCE, and this process option would not be effective for treating contamination at depths greater than a few feet. Contamination is present at greater depths, and the current use of the Site is not conducive to this type of remedy. Additionally, there is the potential for the transfer of contaminants across media (*i.e.*, from soil to air). Therefore, phytoremediation is eliminated from further consideration.

2.4.1.1.6 Disposal

This category of remedial technologies refers to on-site and off-site disposal of contaminated soil or secondary wastes generated from treatment systems, with or without additional treatment. The disposal technologies included in the screening are on-site reuse, construction of a new on-site Resource Conservation and Recovery Act (RCRA), TSCA and/or non-hazardous landfill, disposal at an existing off-site RCRA, TSCA, or non-hazardous landfill, and off-site reuse / recycling.

On-Site Reuse

This option allows for the redeposition of treated soil that does not exceed regulatory criteria as backfill into the excavated area.

Initial Screening: Treated soil and secondary wastes would be utilized to fill excavations. Redeposition of treated soil would reduce the need for additional clean fill from an off-site source. The material to be reused must meet geotechnical requirements and regulatory standards. Wastes from some treatment options may require institutional controls (land use restrictions) for re-use on-site. Since on-site treatment to meet re-use criteria is not feasible due to site conditions, this technology was not retained for further evaluation.

On-Site Landfill

A new disposal facility may be constructed within the property boundaries. A typical landfill facility would consist of a liner system, a leachate collection and treatment system, and a multi-layer cap system including grass seeding. The collected leachate is either treated on-site or disposed at an off-site treatment facility.

Initial Screening: The on-site landfill must meet rigorous regulatory requirements and would require highly detailed engineering controls. The area needed for an on-site landfill is a fairly large area. The small quantity of contaminated soil and limited space available for an on-site landfill make this technology not feasible. This disposal option was not retained for further consideration.

Off-Site Disposal

Contaminated soil and/or secondary wastes (*e.g.*, wastes from other treatment options) could be hauled to an existing off-site landfill.

Initial Screening: Land Disposal Restrictions (LDRs) prohibit disposing of RCRA listed or characteristic wastes that do not meet LDR standards in a landfill. Soils that do not meet LDR standards must first be treated prior to disposal. Additionally, existing licensed non-hazardous landfills within New Jersey or neighboring states could be employed for the disposal of treated soils and secondary wastes that were characterized as non-hazardous. The use of a RCRA Subtitle C landfill may also be required for disposal of excavated soil and secondary wastes from other treatment alternatives. This disposal option was retained for further evaluation.

Reuse/Recycling

Contaminated soil would be transported to a facility that will treat the material to make it suitable for reuse.

Initial Screening: It may be difficult to find appropriate facilities due to hauling distances, media volume, material restrictions, sampling requirements, and costs. Soils containing elevated metal concentrations may not be suitable for reuse or recycling. However, this technology was retained, as some of the site materials may be suitable for reuse or recycling.

2.4.2 Evaluation and Selection of Representative Process Options

For the technically feasible technologies discussed in the previous section and summarized in Table 2-5, process options were evaluated to select a particular process option to represent each technology type during the development of alternatives. Process options were evaluated qualitatively for effectiveness, implementability, and cost relative to other process options within the same technology type, as described below:

- Effectiveness Considerations
 - Ability to meet contaminant reduction goals
 - Effectiveness of protecting human health and the environment during the construction and implementation phases
 - Reliability of the technology with respect to site contaminants and site conditions
- Implementability Considerations
 - Technical and institutional implementability of each process option
- Cost Considerations
 - Relative cost of process options within each technology type

The evaluation of process options against these criteria is presented in Table 2-6. All of the process options evaluated in Table 2-6 were previously determined to be technically feasible based on the screening presented in Table 2-5, and may be incorporated into the final selected remedy. However, based on the effectiveness, implementability, and cost evaluations presented in Table 2-6, the process options identified by an asterisk (*) were selected for development of remedial alternatives.

SECTION 3.0

3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

Process options selected in Section 2.0 for alternative development were combined into potential remedial alternatives for the Site. If necessary, due to development of a large number of alternatives, these potential remedial alternatives would be screened based on effectiveness, implementability, and cost considerations to reduce the number of alternatives for detailed evaluation. However, due to the limited number of alternatives developed, preliminary screening to reduce the number of alternatives was deemed unnecessary.

3.1 Development of Soils Remedial Alternatives

The alternatives for the on-site soils were developed based on the RAO and the following site-specific considerations:

- The majority of the Site is developed; therefore, limitations exist as to the technologies that can be implemented.
- Soils do not pose unacceptable risk to human health, but are likely to be an on-going source of PCE contamination in groundwater.
- The estimated volume of impacted soil (*i.e.*, soil containing concentrations of PCE above IGWSCC) using information provided in the RI Report and additional data from the April 2006 Focused Field Sampling is approximately 40 yd³ of PCE-impacted soil. The total area impacted is approximately 195 ft².
- Based on the BHHRA, the lead detected at the Site does not pose an unacceptable human health risk; lead has not been reported in groundwater at the Site.
- Benzene and methylene chloride do not pose an unacceptable human health risk. They are present at only one location above impact to groundwater screening criteria and this location is under a paved parking area. Benzene and methylene chloride have not been reported in groundwater at the Site. Therefore, the remedial alternatives do not specifically address benzene and methylene chloride.
- The groundwater remedy is in the design phase.

Based on the technology screening and process option evaluation in addition to the above considerations, the potential soil(s) remedial alternatives developed for the Site are as follows:

- S-1: No Action
- S-2: Limited Action
- S-3: *In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal
- S-4: Excavation with Off-Site Treatment and/or Disposal with SVE

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The detailed analysis of remedial alternatives presented in this section consists of the following components and processes:

- Definition of each alternative with respect to the volumes and areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies.
- Assessment of each alternative against seven of the nine evaluation criteria as defined in EPA, 1988; state and community acceptance will be evaluated following the public comment period.
- Comparative analysis among the remedial alternatives to assess the relative performance of each alternative with respect to each evaluation criterion.

4.1 Evaluation Criteria

Based on the statutory preference and the RAO developed in Section 2.0, remedial alternatives must meet the following requirements during evaluation and selection:

- Protection of human health and the environment (CERCLA Section 121(b)).
- Attainment of ARARs of Federal and State laws (CERCLA Section 121(d)(2)(A)) or warranting a waiver under CERCLA Section 121(d)(4).
- Reflection of a cost-effective solution, taking into consideration short- and long-term costs (CERCLA Section 121(a)).
- Use of permanent solutions and treatment technologies or resource recovery technologies to the maximum extent practicable (CERCLA 121(b)).
- Satisfaction of the preference for remedies that employ treatments that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances as a principal element or explanation of reasons why such remedies were not selected (CERCLA Section 121(b)).

In order to address the CERCLA requirements adequately, nine evaluation criteria were developed. The first two criteria are the threshold factors. Any alternative that does not satisfy both of these criteria is dropped from further consideration in the detailed analysis unless justification for waiver of an ARAR exists. These two threshold factors are:

- Overall protection of human health and the environment; and
- Compliance with ARARs.

Five primary balancing criteria are used to make comparisons between the remedial alternatives. Alternatives that satisfy the threshold criteria are evaluated further using the following five criteria:

- Long-term effectiveness;
- Reduction of toxicity, mobility, and/or volume;
- Short-term effectiveness;
- Implementability; and
- Cost.

The remaining two criteria, State and community acceptance, are modifying factors. State acceptance will be evaluated in the Proposed Plan after receiving the State's comments on this FS. The Proposed Plan will identify the remedial alternatives preferred by EPA. The final evaluation criterion, community acceptance, will be presented in the ROD, following the public comment period.

The following sections describe each of the evaluation criteria in more detail.

4.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion provides an overall assessment of protection based on a composite of long-term and short-term effectiveness factors, including:

- How well a specific site remedial action achieves protection over time;
- How well site risks are reduced; and
- How each source of contamination is to be eliminated, reduced, or controlled for each remedial alternative.

4.1.2 Compliance with ARARs

This evaluation criterion is used to determine how each remedial alternative complies with Federal and State ARAR and TBC requirements as defined in CERCLA Section 121. Each alternative is evaluated in detail for:

- Compliance with chemical-specific ARARs;
- Compliance with location-specific ARARs;
- Compliance with action-specific ARARs; and
- Compliance with other applicable criteria, advisories, and guidance (*i.e.*, TBCs).

The ARARs and TBCs used in this evaluation were previously outlined in Section 2.0.

4.1.3 Long-Term Effectiveness

This evaluation criterion addresses the results of the remedial action in terms of the risk remaining after the RAOs have been met. The components of this criterion include the magnitude of the remaining risk measured by numerical standards such as cancer risk levels, the adequacy and stability of controls used to manage treatment residuals or untreated wastes, and the long-term reliability of management controls for providing continued protection from residuals (*i.e.*, the assessment of potential failure of the technical components).

4.1.4 Reduction of Toxicity, Mobility, and/or Volume

This evaluation criterion addresses the statutory preference that treatment results in the reduction of the total mass of toxic contaminants, the irreversible reduction in contaminant mobility, and/or the reduction of the total volume of contaminated media. Factors to be evaluated in this criterion include the following:

- Treatment process employed;
- Amount of hazardous material destroyed or treated;
- Degree of reduction in toxicity, mobility, and/or volume expected; and
- Type and quantity of treatment residuals.

4.1.5 Short-Term Effectiveness

This evaluation criterion addressed the impacts of the remedial action during the construction and implementation phases preceding the attainment of the RAOs. Factors to be evaluated include protection of workers and neighboring communities during the remedial actions, environmental impacts resulting from the implementation of the remedial actions, and the time required for achieving protection.

4.1.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing a remedial action and the availability of various services and materials required during its implementation.

Technical feasibility factors include:

- Construction and operation difficulties;
- Reliability of the technology;
- Ease of undertaking additional remedial actions, if necessary; and
- The ability to monitor the effectiveness of the remedy.

The administrative feasibility factors include:

- The ability and time required for permit approval and for activities needed to coordinate with other agencies;
- The availability of services and materials including availability of treatment, storage, and disposal services with required capacities;
- The availability of equipment and specialists; and
- The availability of prospective technologies for competitive bidding.

4.1.7 Cost

This criterion addresses capital costs, Operation and Maintenance (O&M) costs, present worth of capital and O&M costs, and potential future remedial action costs. Capital costs consist of direct and indirect costs. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, financial, and other services required for completing the installation of the remedial alternatives. Other annual O&M costs are incurred after the remedial activities are completed.

This assessment evaluates the costs of the remedial actions on the basis of present worth. Present worth analysis allows remedial alternatives to be compared on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial alternative over its planned life. A required operating performance period is assumed for present worth, which is a function of the discount rate and time. A discount rate of five percent is assumed for the base calculation. The "study estimate" costs provided for the remedial actions are intended to reflect actual costs with the accuracy of -30 to +50 percent.

4.2 **Detailed Analysis of Alternatives**

4.2.1 Alternative S-1: No Action

The No Action Alternative for contaminated soil would only include five-year reviews to assess the need for future remedial actions. Contaminated soils would be left in place with no treatment or controls to

mitigate contaminant migration. The No Action Alternative has been retained, as required by CERCLA, to provide a baseline to compare the other alternatives.

4.2.1.1 Overall Protection of Human Health and the Environment

Under this alternative, no active remedial measures would be employed. Overall, the contaminated soils do not pose an unacceptable risk to human health. However, contaminated soil may serve as an ongoing source for groundwater contamination. Unacceptable groundwater risk would not be mitigated by the No Action Alternative. The potential for unacceptable indoor air exposures would also persist. Because this alternative leaves contamination in place above applicable criteria, five-year reviews would be required. These reviews would include assessment of human health risks and potential impacts to groundwater and indoor air as well as the need for future remedial actions.

4.2.1.2 Compliance with ARARs

This alternative would not comply with chemical-specific TBCs (*i.e.*, NJDEP SCC and Soil Vapor Guidance (SVG)). Chemical-specific ARARs have not been identified for soils as there are no promulgated cleanup standards for soil. Since this alternative includes no active remedial measures, contaminants will remain in place above the TBCs. As no active remedial measures would be employed, this alternative would not trigger location- or action-specific ARARs.

4.2.1.3 Long-Term Effectiveness

No active remedial measures or institutional or engineering controls would be employed to address the existing site conditions. The RAO identified in Section 2.0 would not be met and unacceptable risks, if any, associated with contaminants leaching from soil to groundwater and/or contributing to indoor air concerns would not be mitigated.

4.2.1.4 Reduction of Toxicity, Mobility, and/or Volume

The No Action Alternative would not result in a reduction of toxicity, mobility, and/or volume of contaminants since no active remedial measures would be employed.

4.2.1.5 Short-Term Effectiveness

Since no active remedial measures would be employed under this alternative, there would be no increased risk to workers or the public as a result of implementing this alternative.

4.2.1.6 Implementability

There are no technical feasibility issues associated with the No Action Alternative. Administratively, this alternative would require coordination with State and Local authorities in reviewing five-year reviews and making decisions regarding any future remedial activities, if necessary. This alternative would not require any permits. This alternative would not require any remediation services or materials. Consulting services would be required for five-year reviews; these services are readily available.

4.2.1.7 Cost

No capital or O&M costs are associated with this alternative.

4.2.2 Alternative S-2: Limited Action

The Limited Action Alternative would include implementation of public education programs and deed notices/restrictions. The public education programs would be aimed at informing the public about potential hazards posed by exposure to contaminants in the soil. The deed notice/restriction, or comparable administrative control, would be implemented to ensure that future activities at the Site (*e.g.*, excavation) would be performed with knowledge of the Site conditions and implementation of

appropriate health and safety controls. Because this alternative leaves contamination in place above applicable criteria, five-year reviews would be required. These reviews would include assessment of human health risks and potential impacts to groundwater and indoor air as well as the need for future remedial actions.

4.2.2.1 Overall Protection of Human Health and the Environment

Under this alternative, no active remedial measures would be employed. Overall, the contaminated soils do not pose an unacceptable risk to human health. However, contaminated soil may serve as an on-going source for groundwater contamination. Unacceptable groundwater risks may be mitigated by the public awareness program and/or deed notices/restrictions under the Limited Action Alternative. The potential for unacceptable indoor air exposures would persist. Because this alternative leaves contamination in place above applicable criteria, five-year reviews would be required. These reviews would include assessment of human health risks, potential impacts to groundwater and indoor air, effectiveness of the institutional controls, and the need for future remedial actions.

4.2.2.2 Compliance with ARARs

This alternative would not comply with chemical-specific TBCs (i.e. NJDEP SCC and SVG). Since this alternative includes no active remedial measures, contaminants will remain in place above the TBCs. As no active remedial measures would be employed, this alternative would not trigger location- or action-specific ARARs.

4.2.2.3 Long-Term Effectiveness

Institutional controls would be implemented to address the existing site conditions. Risks associated with the potential leaching of soil contaminants to groundwater might be mitigated through use of public education and/or deed restrictions to reduce exposures. However, the contaminated soil would remain and exposures could occur if the public awareness program or deed restrictions were violated.

4.2.2.4 Reduction of Toxicity, Mobility, and/or Volume

The Limited Action Alternative would not result in a reduction of toxicity, mobility, and/or volume of contaminants since no active remedial measures would be employed.

4.2.2.5 Short-Term Effectiveness

Since no active remedial measures would be employed under this alternative, there would be no increased risk to workers or the public as a result of implementing this alternative.

The institutional controls associated with this alternative could be implemented within six months of alternative selection.

4.2.2.6 Implementability

There are no technical feasibility issues associated with the Limited Action Alternative. Administratively, this alternative would require coordination in implementing the deed notice/restriction and public awareness program. Coordination with State and local authorities in reviewing five-year reviews and making decisions regarding any future remedial activities, if necessary. This alternative would not require any permits. This alternative would not require any remediation services or materials. Consulting services would be required for implementation of institutional controls, public awareness, and five-year reviews; these services are readily available.

4.2.2.7 Cost

The capital cost for the Limited Action Alternative is estimated to be \$27,000. The net present value of this alternative is estimated to be \$27,000, based on 1 to 2 years of operation and a 5% discount rate. Data in support of these cost estimates are presented in Appendix B.

4.2.3 Alternative S-3: In-Situ Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal

Alternative S-3 involves use of SVE in an effort to address the RAO by removing PCE as a potential ongoing source for groundwater contamination. A hot spot excavation to remove approximately 20 yd³ of PCE contaminated soil at Wholly Scrap! would be conducted, while SVE would be used at Lusardi's Cleaners to remediate PCE in the unsaturated (vadose) zone soil. To implement SVE, a vacuum is applied to the soil to induce the controlled flow of air to remove VOCs from the soil via a network of vertical or horizontal extraction wells. The estimated area of PCE-impacted soil, based on information provided in the RI Report and the April 2006 Focused Field Sampling, is 195 ft².

Generally, the radius of influence for an SVE well ranges from 15 to 100 feet (Hutzler *et al.* 1989). Using the areas and depths identified above, 1 SVE well with an assumed radius of influence of 15 feet would be installed to a depth of approximately 10 feet bgs to address the PCE contamination in soil (see Figure 4-1). In the absence of a pilot study, a conservative value of 15 feet for the radius of influence was selected. A pilot test could be performed to determine optimum design parameters such as radius of influence and vapor flow rate; however, due to the small area of contamination, a system could likely be designed without pilot testing by using conservative assumptions. An extension of the SVE system (with two additional extraction points) under the Lusardi's Cleaners is also included as a contingency should additional contamination be identified beneath the building during the RA.

SVE may not be able to completely treat the contaminated soil to meet the TBCs, particularly beneath structures that cannot be disturbed. Therefore, institutional controls (*e.g.*, a deed notice), as described in Alternative S-2, may be required as part of this alternative.

Due to archeological and historic architectural sensitivity at the Site, additional archeological monitoring was recommended in the RI Report for future intrusive investigation activities. Since Alternative S-3 includes intrusive work, additional archeological monitoring would be performed at the Site during implementation of this alternative. Costs for archeological monitoring were included in the remedial alternative cost estimate.

4.2.3.1 *Overall Protection of Human Health and the Environment*

Alternative S-3 would reduce leaching of PCE from soil to groundwater. Implementation of SVE would result in air emissions which could pose a risk to workers and the nearby community. Granular Activated Carbon (GAC) would be used to treat the vapor stream prior to discharge to mitigate these potential risks. The hot spot excavation and off-site disposal of PCE-contaminated soil would mitigate the potential for contaminant migration to groundwater and indoor air. Off-site facilities are designed and operated to be protective of human health and the environment. Potential risks of exposure for workers and the public may exist during implementation of this alternative due to dust and volatile emissions; air monitoring and appropriate health and safety precautions in addition to engineering controls would be implemented to mitigate these potential risks.

4.2.3.2 *Compliance with ARARs*

The SVE component of this alternative would comply with chemical-specific TBCs for soil. Contaminants above the TBCs would be removed from the vadose zone, transferred to the vapor stream,

and removed using GAC. The spent GAC would be disposed of or regenerated at a permitted off-site facility. This SVE component is not expected to trigger location-specific ARARs and the remedial measures will not take place within any sensitive environments (e.g., wetlands). However, should the remediation area expand into the Morris Canal, requirements of the National Register of Historic Places would be triggered for any disturbance of the Canal.

Alternative S-3 would need to be performed in accordance with action-specific ARARs. The SVE system will include necessary air emission controls to comply with NJDEP Air Quality regulations. Generated wastes will be tested, managed, transported, and disposed of in accordance with applicable Federal and State regulations.

For the hot spot excavation component, no chemical-specific ARARs were identified. Approximately 20 yd³ of soil with contaminants above the TBCs would be removed from the Site and disposed at an off-site facility. This component is not expected to trigger location-specific ARARs, as no on-site disposal will take place, and the remediation will not take place within any sensitive environs. However, should the remediation area expand into the Morris Canal, requirements of the National Register of Historic Places would be triggered for any disturbance of the Canal.

This alternative would be performed in accordance with action-specific ARARs as active remediation will take place. Generated wastes will be tested, managed, transported, and disposed in accordance with Federal and State regulations. Excavation could result in generation of fugitive dust emissions. Proper erosion and sediment control measures as well as dust suppression techniques would be implemented to comply with ARARs.

4.2.3.3 Long-Term Effectiveness

The excavation and removal and *in situ* treatment of contaminated soil would reduce the leaching of PCE from contaminated soils to groundwater. Off-site disposal or treatment (*i.e.*, regeneration) facilities for the spent GAC would be properly designed and operated in accordance with Federal and State regulations; thus, long-term risks and liabilities posed by off-site disposal or regeneration of GAC would be minimized. For removed soils, off-site disposal facilities would be properly designed and operated in accordance with Federal and State regulations; thus, long-term risks and liabilities posed by off-site disposal would be minimized. It should be noted that excavation and off-site disposal and *in situ* treatment (SVE) represent an irreversible remedy for contaminated soils onsite.

4.2.3.4 Reduction of Toxicity, Mobility, and/or Volume

In situ treatment (SVE) would transfer contaminants from the soil media to GAC which can be disposed of or treated at an off-site facility. Although this would not reduce the toxicity of the contaminants, it would reduce the volume of contaminated media. Disposal or treatment in an appropriately permitted off-site facility would significantly reduce the mobility of contaminants.

Off-site disposal of excavated soil would remove contaminated soil from areas where it could continue to act as a potential source for groundwater contamination. However, it would not reduce the toxicity or volume of contaminants. Disposal in an appropriately permitted off-site facility would significantly reduce the mobility of contaminants. Treatment of soils, if necessary to meet disposal facility requirements, could potentially reduce the volume and toxicity of contaminants.

4.2.3.5 Short-Term Effectiveness

Implementation of this alternative could be accomplished with minimal risk to construction workers and the community. During installation of extraction wells, there would be a risk of exposure due to direct contact and inhalation of contaminants. During these activities, personal protective equipment (PPE)

would be used as necessary. During excavation and loading activities, there would be a potential risk of exposure due to direct contact and inhalation of contaminants. Air monitoring would be performed to ensure that workers and the public are not exposed to unacceptable contaminant levels during remediation. During remediation activities, PPE would be used, as required, to protect workers from unacceptable exposures. There would be an increase in truck traffic and associated noise as well as an increase in dust levels during construction. Air and noise monitoring, as necessary, would be performed to ensure that workers and the public are not exposed to unacceptable contaminant and/or noise levels during remediation. Other safety concerns include physical hazards related to construction. Therefore, access to the construction areas would be restricted during construction activities.

The overall design of this alternative could be performed within approximately six months. Hot-spot excavation would be performed in one year. Construction and operation of the SVE system would require approximately an additional one to two years, depending on the system operation time needed to achieve the RAO.

4.2.3.6 Implementability

Excavation and SVE are widely used technologies for treatment of PCE-contaminated soils. Therefore, no technical feasibility issues are anticipated associated with Alternative S-3. Administratively, this alternative would require coordination during construction activities in order to obtain access to the planned locations for the extraction wells and associated treatment equipment. The SVE component would involve air permit equivalencies and may require local building permits, depending on Rockaway Borough regulations. Services and materials for pilot testing (if performed), design, and implementation of this alternative are readily available. Administratively, this alternative would require coordination during construction activities in order to obtain access to the Site and neighboring properties.

4.2.3.7 Cost

The capital cost for this alternative is estimated to be \$360,000. This cost is based on the current delineation of contaminated soil and could be impacted by pre-design delineation sampling and/or post-excavation samples during the remedial action. The net present value of this alternative is estimated to be \$360,000, based on 1-2 years of operation. The predicted cost for contingency SVE treatment beneath the building is estimated to be \$50,000. Data in support of these cost estimates are presented in Appendix B.

4.2.4 Alternative S-4: Excavation with Off-Site Treatment and/or Disposal with SVE

In this alternative, PCE-contaminated soils are removed via excavation. The excavated material would be disposed of off-site, at a facility designed and permitted for disposal of PCE-contaminated soil. As recommended in the RI Report, additional soil sampling was performed prior to the FS in April 2006, in order to characterize the vertical extent and southern horizontal boundaries of the contamination on the Wholly Scrap! property. The estimated volume of impacted soil, based on information provided in the RI Report and the additional data in Appendix A, is approximately 40 yd³ excluding contamination that may be located beneath the buildings (see Figure 4-2). However, additional action level exceedances could be detected during pre-design delineation sampling and/or post-excavation confirmatory sampling, which could increase the scope of the remedial construction.

Excavated soils would be analyzed for disposal parameters and would be containerized for off-site disposal. The excavated soils would then be trucked off-site for treatment, as needed, and disposed in accordance with Federal and State regulations. Upon completion of contaminated soil removal, the excavation would be backfilled with select fill, compacted, and the surface would be restored.

Excavation would remove contaminated soil and meet the NJDEP SCC; post-excavation sampling would confirm that the criteria have been met. However, it may not be feasible to remove all contaminated soil,

particularly contaminated soil that may be present beneath structures that cannot be disturbed. Therefore, an installation of an SVE system (with two extraction points) under the Lusardi's Cleaners is included as a contingency should additional sources be identified. Institutional controls (e.g., deed notice/restriction) and five-year reviews, as described in Section 4.2.2, may be required as part of this alternative.

Due to archaeological and historic architectural sensitivity at the Site, additional archaeological monitoring was recommended in the RI Report for future intrusive activities. Since the Excavation with Off-Site Disposal Alternative includes intrusive work, additional archaeological monitoring would be performed at the Site during implementation of this alternative. Costs for archaeological monitoring were included in the cost estimate for this alternative.

4.2.4.1 Overall Protection of Human Health and the Environment

Excavation and off-site disposal of PCE-contaminated soil would mitigate the potential for contaminant migration to groundwater and indoor air. Off-site facilities are designed and operated to be protective of human health and the environment. Potential risks of exposure for workers and the public may exist during implementation of this alternative due to dust and volatile emissions; air monitoring and appropriate health and safety precautions in addition to engineering controls would be implemented to mitigate these potential risks. Implementation of the SVE contingency would result in air emissions which could pose a risk to workers and the nearby community. GAC would be used to treat the vapor stream prior to discharge to mitigate these potential risks.

4.2.4.2 Compliance with ARARs

Except as discussed above for areas beneath buildings, this alternative would comply with chemical-specific TBCs for soil. As discussed previously, no chemical-specific ARARs were identified. Soil with contaminants above the TBCs would be removed from the Site and disposed at an off-site facility. This alternative is not expected to trigger location-specific ARARs, as no on-site disposal will take place, and the remediation will not take place within any sensitive environs. However, should the remediation area expand into the Morris Canal, requirements of the National Register of Historic Places would be triggered for any disturbance of the Canal.

This alternative would need to be performed in accordance with action-specific ARARs as active remediation will take place. Generated wastes will be tested, managed, transported, and disposed in accordance with Federal and State regulations. Excavation could result in generation of fugitive dust emissions. Proper erosion and sediment control measures as well as dust suppression techniques would be implemented to comply with ARARs.

The SVE component of this alternative would comply with chemical-specific TBCs for soil. Contaminants above the TBCs would be removed from the vadose zone, transferred to the vapor stream, and removed using GAC. The spent GAC would be disposed of or regenerated at a permitted off-site facility. This SVE component is not expected to trigger location-specific ARARs and the remedial measures will not take place within any sensitive environments (e.g., wetlands).

4.2.4.3 Long-Term Effectiveness

Excavation and removal of contaminated soil would reduce leaching of PCE from contaminated soils to groundwater. Off-site disposal facilities would be properly designed and operated in accordance with Federal and State regulations; thus, long-term risks and liabilities posed by off-site disposal would be minimized. It should be noted that excavation and off-site disposal represents an irreversible remedy for contaminated soils.

If additional contamination is encountered beneath Lusardi's Cleaners, implementation of the contingency SVE system will achieve TBCs and meet RAOs by reducing leaching of PCE from contaminated soils beneath the building to groundwater. The contingency plan includes off-site disposal or treatment (i.e., regeneration) facilities for the spent GAC that would be properly designed and operated in accordance with Federal and State regulations; thus, long-term risks and liabilities posed by off-site disposal or regeneration of GAC would be minimized. Contingency *In situ* treatment (SVE) represents an irreversible remedy for contaminated soils beneath the building.

4.2.4.4 Reduction of Toxicity, Mobility, and/or Volume

Off-site disposal would remove contaminated soil from areas where it could continue to act as a potential source for groundwater contamination. However, it would not reduce the toxicity or volume of contaminants. Disposal in an appropriately permitted off-site facility would significantly reduce the mobility of contaminants. Treatment of soils, if necessary to meet disposal facility requirements, could potentially reduce the volume and toxicity of contaminants.

If additional contamination is encountered beneath Lusardi's Cleaners, contingency SVE treatment would be applied and would transfer contaminants from the soil media beneath the building to GAC which can be disposed of or treated at an off-site facility. Although this would not reduce the toxicity of the contaminants, it would reduce the volume of contaminated media. Disposal or treatment in an appropriately permitted off-site facility would significantly reduce the mobility of contaminants.

4.2.4.5 Short-Term Effectiveness

Implementation of this alternative could be accomplished with minimal risk to construction workers and the community. During excavation and loading activities, there would be a potential risk of exposure due to direct contact and inhalation of contaminants. Air monitoring would be performed to ensure that workers and the public are not exposed to unacceptable contaminant levels during remediation. During remediation activities, PPE would be used, as required, to protect workers from unacceptable exposures. Other safety concerns include physical hazards related to construction. There would be an increase in truck traffic and associated noise and an increase in dust levels during construction. Potential risk to the community could result from transport of material along public roads. Dust control procedures would be required in order to minimize fugitive dust emissions and appropriate containers would be used for transportation to minimize these potential risks. Access to the construction areas would be restricted during construction activities.

Design of this alternative could be performed within approximately six months of selection of this alternative. The implementation of this alternative would require less than one month for excavation, but three to six months for implementation of institutional controls, if necessary.

If additional contamination is found beneath Lusardi's Cleaners, it would be treated by the contingency SVE system. This treatment could be designed within approximately six months to one year of contamination discovery beneath the building. Construction and operation of the SVE system would require approximately an additional one to two years, depending on the system operation time needed to achieve the RAO.

4.2.4.6 Implementability

Conventional excavation and construction technologies would be implemented under this Alternative. Some shoring or other specialized excavation techniques may be required for excavation in close proximity to building foundations. There are no other technical feasibility concerns associated with this alternative. Administratively, this alternative would require coordination during construction activities in order to obtain access to the Site and neighboring properties. Services and materials for excavation and

disposal, are readily available. SVE is a widely used technology for *in situ* treatment of PCE-contaminated soils. Therefore, no technical feasibility issues are anticipated associated with the SVE component of this Alternative. Administratively, this alternative would require coordination during construction activities in order to obtain access to the planned locations for the extraction wells and associated treatment equipment. The SVE component would involve air permit equivalencies and may require local building permits, depending on Rockaway Borough regulations. Services and materials for pilot testing (if performed), design, and implementation of this alternative are readily available.

4.2.4.7 Cost

The capital cost for this alternative is estimated to be \$46,000. This cost is based on the current delineation of the contaminated soil, and could be impacted by pre-design delineation sampling and/or post-excavation samples during the remedial action. There is no annual O&M cost associated with this alternative. The net present value of this alternative is estimated to be \$46,000, based on 1-2 years of operation. The predicted cost of future SVE treatment of the soil under Lusardi's Cleaners is estimated to be \$274,000. Data in support of these cost estimates are presented in Appendix B.

4.3 Comparative Analysis of Alternatives

The following sections compare the relative performance of each alternative for each of the evaluation criteria, and highlights the substantive differences between the four remedial alternatives. Table 4-1 summarizes the comparative analysis.

4.3.1 Overall Protection of Human Health and the Environment

Implementation of Alternative S-1 (No Action) or Alternative S-2 (Limited Action) would not achieve the RAOs. The potential for migration of PCE from contaminated soil to groundwater and the potential for indoor air exposures would persist. Alternative S-2 would potentially provide some risk reduction through institutional controls such as land use restrictions and public education. Alternative S-3 (*In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal) and Alternative S-4 (Excavation with Off-Site Treatment and/or Disposal with SVE) are more protective of human health and the environment, since these alternatives would treat and remove the PCE-contaminated soil. Alternative S-4 may be somewhat more protective than Alternative S-3, since contaminated soils would be removed from the site. Alternatives S-3 and S-4 both have the potential to leave behind some residual contamination due to treatment limitations (S-3) and inaccessible areas beneath the buildings (S-3 and S-4). If additional contamination is encountered beneath Lusardi's Cleaners, a contingency plan for SVE treatment of contaminated media would be applied to both Alternatives S-3 and S-4.

4.3.2 Compliance with ARARs

Alternative S-1 and Alternative S-2 would not comply with chemical-specific TBCs, since contaminated soil would remain on-site above the NJDEP SCC. Alternative S-3 would comply with chemical-specific TBCs for soil with the possible exception of some areas beneath the buildings. Alternative S-4 would also comply with chemical-specific TBCs, with the possible exception of areas beneath the buildings. If contamination is found beneath Lusardi's Cleaners, a contingency plan will treat the additional contamination to achieve the TBCs and meet RAOs.

Alternative S-1 and Alternative S-2 would not trigger location or action-specific ARARs as no active remediation would take place. Alternative S-3 and Alternative S-4 are not expected to trigger location-specific ARARs, as no on-site disposal will take place and the remediation will not take place within sensitive environs. However, should the remediation area expand to the former Morris Canal, National Register of Historic Places requirements would be triggered. Alternatives S-3 and S-4 would trigger

action-specific ARARs, as active remediation will take place. Generated wastes will be tested, managed, transported, and disposed in accordance with Federal and State regulations. Proper erosion and sediment control measures, dust suppression techniques, and air emission controls would be implemented to comply with ARARs.

4.3.3 Long-Term Effectiveness

The magnitude of residual risks is highest for Alternatives S-1 and S-2. Alternative S-2 relies on land use restrictions and public education programs aimed at informing the public about potential hazards posed by exposure to contaminants in the soil. Alternatives S-3 and S-4 both mitigate the ongoing source of groundwater contamination and the potential for indoor air exposures through active remediation. Alternative S-3 uses limited excavation and *in situ* treatment to reduce contaminant mass in the vadose zone. Alternative S-4 uses excavation and off-site disposal to remove contaminant mass from the Site with the contingency to use *in situ* treatment should additional sources be located. Alternatives S-3 and S-4 are both permanent remedies.

4.3.4 Reduction of Toxicity, Mobility, or Volume

Neither Alternative S-1 nor Alternative S-2 provides a reduction of toxicity, mobility, or volume of contaminated soils. Alternatives S-3 and S-4 would reduce contaminant mobility through removal and disposal or regeneration of the spent GAC and removal and disposal of soils at approved off-site facilities. Alternative S-3 (and potentially Alternative S-4 if the SVE contingency is implemented) would also reduce the volume of contaminated media by transferring contaminants from soil to GAC. For Alternatives S-3 and S-4, pre-disposal treatment, if necessary, could potentially reduce the toxicity and volume of the contaminated soils.

4.3.5 Short-Term Effectiveness

No short-term adverse impacts to workers or the community would be expected for Alternatives S-1 or S-2. Alternatives S-3 and S-4 would cause an increase in truck traffic, noise, and potentially dust in the surrounding area, as well as potential impacts to workers and the nearby community during remedial actions. These potential impacts would be created through construction activities and exposure to the contaminated media. Air monitoring, engineering controls, personal protective equipment, and safe work practices would be used to address potential impacts to workers and the community.

No environmental impacts would be expected from Alternatives S-1 or S-2. For Alternative S-3 (and potentially Alternative S-4), air emission controls would be needed to prevent outdoor air concerns. For Alternatives S-3 and S-4, erosion control and dust control measures would be needed to mitigate potential impacts.

Alternative S-1 would not require any time to implement, as no action would be taken. Alternative S-2 would require approximately six months to implement. Alternative S-3 (and potentially Alternative S-4) would require approximately six months to one year for pilot testing (if performed) and design, and an additional one to two years to implement, depending on the required SVE treatment duration to achieve the cleanup criteria. Alternative S-4 without implementing the SVE contingency would require approximately six months for design, and an additional three to six months to implement.

4.3.6 Implementability

Alternatives S-1 and S-2 include periodic reviews and inspections as a means of monitoring the effectiveness of the remedy. Consulting services associated with these reviews are readily available. The technical components of Alternatives S-3 and S-4 would be easily implemented using conventional construction equipment and materials; however, some specialized techniques may be required for Alternative S-4 for excavation in close proximity to building foundations. Equipment and installation vendors for the SVE system in Alternatives S-3 and S-4 (if contingency SVE is implemented) are readily available. Off-site disposal facilities are available for the disposal of the contaminated media for Alternatives S-3 and S-4.

4.3.7 Cost

Alternative S-1 would have no capital cost. Alternative S-2 would be the next lowest cost alternative, since it involves only administrative measures. Alternative S-2 would have a present worth of \$27,000. Alternative S-3 would have a present worth cost of \$360,000 with a predicted cost of \$50,000 for contingency SVE treatment. Alternative S-4 would have a present worth cost of \$46,000 with a predicted cost of \$274,000 for contingency SVE treatment.

5.0 REFERENCES

Drake *et al.*, 1996. "Bedrock Geologic Map of New Jersey, with USGS and NJGS."

EPA, 2002. "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater to Soil."

EPA, 2001. "Risk Assessment Guidance for Superfund (RAGS) (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments), (Interim), Office of Solid Waste and Emergency Response, Washington, D.C."

EPA, 1993. "Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soil," OSWER Directive 9655-0-48FS (EPA 540-F-93-048).

EPA, 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," Office of Emergency and Remedial Response, Washington, D.C., (Interim Final).

EPA, 1985. "Revised Handbook for Remedial Action at Waste Disposal Sites," OHEA EPA 600/6-88/005A.

Gill, H.E. and Vecchioli, J., 1965. "Availability of Groundwater in Morris County Special Report No. 25, NJDEP and USGS."

Hutzler, N.J., B.E. Murphy, and J.S. Gierke. 1989. Review of Soil Vapor Extraction System Technology. Presented at the Soil Vapor Extraction Technology Workshop, Office of Research and Development, Edison, NJ. June 28-29.

ICF, 1991. "Draft Final Remedial Investigation Report, Rockaway Borough Wellfield Site." ICF Technology.

Rossi, J., 2004. "Tom Fowler's Visit to Superintendent, Rockaway Borough of Public Works."

TtEC, 2005. "Remedial Alternatives Evaluation Technical Memorandum for Soils at Rockaway Borough Wellfield Superfund Site, Wall Street / East Main Street Site, Morris County, New Jersey."

TtFW, 2005a. "Final Remedial Investigation Report for the Wall Street / East Main Street Site (the Site) of the Rockaway Borough Wellfield Superfund Site, Rockaway Borough, New Jersey Superfund Site."

TtFW, 2005b. "Remedial Alternatives Screening Technical Memorandum for Soils, at Rockaway Borough Wellfield Superfund Site, Wall Street / East Main Street Site, Morris County, New Jersey."

TtFW, 2004. "Pathways Analysis Report for Remedial Investigation/Feasibility Study, Rockaway Borough Wellfield Superfund Site, Wall Street/East Main Street Site, Rockaway Borough, Morris County, NJ."

TtFW, 2003. "Final Remedial Investigation/Feasibility Study Work Plan, Rockaway Borough Wellfield RI/FS, Wall Street/East Main Street Site, Morris County, New Jersey."

TtFW, 2002, "Quality Assurance Project Plan, "Rockaway Borough Wellfield Superfund Site, Wall Street/East Main Street Site, Rockaway Borough, Morris County, NJ."

6.0 GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	Chemicals of Concern
COPC	Chemicals of Potential Concern
CRA	Conestoga-Rovers & Associates
CSM	Conceptual Site Model
CT	Central Tendency
cy	cubic yard
DCA	Dichloroethene
DCE	Dichloroethene
DHSM	Department of Hazardous Site Mitigation
DI	Deionized
DRE	Destruction and Removal Efficiency
EPA	United States Environmental Protection Agency
FS	Feasibility Study
GAC	Granular Activated Carbon
GC	Gas Chromatograph
gpd	Gallons per day
gpm	Gallons per minute
GRA	General Response Action
HASP	Health and Safety Plan
HI	Hazard Index
ICF	ICF Technology, Inc.
IDW	Investigation Derived Waste
IGWSCC	Impact to Groundwater Soil Cleanup Criteria
ISV	<i>In Situ</i> Vitrification
LDR	Land Disposal Restriction
mg/kg	Milligrams per kilogram
MLTS	Material Licensing Tracking System
MODD	Modified Wetland
ms/m	millisiemens per meter
msl	mean sea level
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NRHP	National Register of Historical Places
NTIS	National Technical Information Service
NWI	National Wetlands Inventory

O&M	Operation and Maintenance
OD	Outside Diameter
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PADS	PCB Activity Database System
PAR	Pathways Analysis Report
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PFO	Palustrine Forested
PID	Photoionization Detector
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
PSS	Palustrine Scrub Shrub
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAMP	Remedial Action Master Plan
RAO	Remedial Action Objective
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RHU	Rockaway-Hibernia-Urban land association
RI	Remedial Investigation
RIR	Remedial Investigation Report
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SD	Standard Deviation
SHWS	State Hazardous Waste Sites
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SOW	Statement of Work
SSL	Soil Screening Levels
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SVG	Soil Vapor Guidance
TBC	To Be Considered
TCA	Trichlorethane
TCE	Trichloroethene
TCL	Target Compound List

TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
TtEC	Tetra Tech EC, Inc.
TtFW	Tetra Tech FW, Inc.
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter
USFWS	United States Fish and Wildlife Service
UST	Underground Storage Tank
VOC	Volatile Organic Compound

TABLES

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-11 RCK-SSS11-0001 B16A1 4/19/2006 0-1 (ug/kg)	S-11 RCK-SBS11-0204 B16A3 4/19/2006 2-4 (ug/kg)	S-11 RCK-SBS91-0204 B16A2 Duplicate of RCK-SBS11-0204 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	5.2 U	6 U	5.6 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	5.2 U	6 U	5.6 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	5.2 U	6 U	5.6 U
1,1,2-Trichloroethane	1000	420000	22000	5.2 U	6 U	5.6 U
1,1-Dichloroethane	10000	1000000	570000	5.2 U	6 U	5.6 U
1,1-Dichloroethene	10000	150000	8000	5.2 U	6 U	5.6 U
1,2,3-Trichlorobenzene	NC	NC	NC	5.2 U	6 U	5.6 U
1,2,4-Trichlorobenzene	100000	1200000	68000	5.2 U	6 U	5.6 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	5.2 U	6 U	5.6 U
1,2-Dibromoethane	NC	NC	NC	5.2 U	6 U	5.6 U
1,2-Dichlorobenzene	50000	10000000	5100000	5.2 U	6 U	5.6 U
1,2-Dichloroethane	1000	24000	6000	5.2 U	6 U	5.6 U
1,2-Dichloropropane	NC	43000	10000	5.2 U	6 U	5.6 U
1,3-Dichlorobenzene	100000	10000000	5100000	5.2 U	6 U	5.6 U
1,4-Dichlorobenzene	100000	10000000	570000	5.2 U	6 U	5.6 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	10 U	12 U	11 U
2-Hexanone	NC	NC	NC	10 U	12 U	11 U
4-Methyl-2-pentanone	50000	1000000	1000000	10 U	12 U	11 U
Acetone	100000	1000000	1000000	10 U	12 U	11 U
Benzene	1000	13000	3000	5.2 U	6 U	5.6 U
Bromochloromethane	NC	NC	NC	5.2 U	6 U	5.6 U
Bromodichloromethane	1000	46000	11000	5.2 U	6 U	5.6 U
Bromoform	1000	370000	86000	5.2 U	6 U	5.6 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400063

**Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results**

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-11 RCK-SSS11-0001 B16A1 4/19/2006 0-1 (ug/kg)	S-11 RCK-SBS11-0204 B16A3 4/19/2006 2-4 (ug/kg)	S-11 RCK-SBS91-0204 B16A2 Duplicate of RCK-SBS11-0204 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	5.2 U	6 U	5.6 U
Carbon disulfide	NC	NC	NC	5.2 U	6 U	5.6 U
Carbon tetrachloride	1000	4000	2000	5.2 U	6 U	5.6 U
Chlorobenzene	1000	680000	37000	5.2 U	6 U	5.6 U
Chloroethane	NC	NC	NC	5.2 U	6 U	5.6 U
Chloroform	1000	28000	19000	5.2 U	6 U	5.6 U
Chloromethane	10000	1000000	520000	5.2 U	6 U	5.6 U
cis-1,2-Dichloroethene	1000	1000000	79000	5.2 U	6 U	5.6 U
cis-1,3-Dichloropropene	1000	5000	4000	5.2 U	6 U	5.6 U
Cyclohexane	NC	NC	NC	5.2 U	6 U	5.6 U
Dibromochloromethane	1000	1000000	110000	5.2 U	6 U	5.6 U
Dichlorodifluoromethane	NC	NC	NC	5.2 U	6 U	5.6 U
Ethylbenzene	100000	1000000	1000000	5.2 U	6 U	5.6 U
Isopropylbenzene	NC	NC	NC	5.2 U	6 U	5.6 U
(m+p)xylene	67000*	1000000*	410000*	5.2 U	6 U	5.6 U
Methyl Acetate	NC	NC	NC	5.2 U	6 U	5.6 U
Methyl tert-butyl ether	NC	NC	NC	5.2 U	6 U	5.6 U
Methylcyclohexane	NC	NC	NC	5.2 U	6 U	5.6 U
Methylene chloride	1000	210000	49000	7.2	3.4 J	5 J
o-Xylene	67000*	1000000*	410000*	5.2 U	6 U	5.6 U
Styrene	100000	97000	23000	5.2 U	6 U	5.6 U
Tetrachloroethene	1000	6000	4000	4.1 J	6 U	5.6 U
Toluene	500000	1000000	1000000	5.2 U	6 U	5.6 U
trans-1,2-Dichloroethene	50000	1000000	1000000	5.2 U	6 U	5.6 U
Trans-1,3-Dichloropropene	1000	5000	4000	5.2 U	6 U	5.6 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400064

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-11 RCK-SSS11-0001 B16A1 4/19/2006 0-1 (ug/kg)	S-11 RCK-SBS11-0204 B16A3 4/19/2006 2-4 (ug/kg)	S-11 RCK-SBS91-0204 B16A2 Duplicate of RCK-SBS11-0204 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	5.2 U	6 U	5.6 U
Trichlorofluoromethane	NC	NC	NC	5.2 U	6 U	5.6 U
Vinyl chloride	10000	7000	2000	5.2 U	6 U	5.6 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:

J - Estimated

R - Rejected

U - Non-detect

400065

**Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results**

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-12 RCK-SSS12-0001 B16B0 4/19/2006 0-1 (ug/kg)	S-12 RCK-SBS12-0204 B16B1 4/19/2006 2-4 (ug/kg)	S-13 RCK-SSS13-0001 B16B4 4/19/2006 0-1 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	6.4 U	5.1 U	4.9 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	6.4 U	5.1 U	4.9 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
1,1,2-Trichloroethane	1000	420000	22000	6.4 U	5.1 U	4.9 U
1,1-Dichloroethane	10000	1000000	570000	6.4 U	5.1 U	4.9 U
1,1-Dichloroethene	10000	150000	8000	6.4 U	5.1 U	4.9 U
1,2,3-Trichlorobenzene	NC	NC	NC	6.4 U	5.1 U	R
1,2,4-Trichlorobenzene	100000	1200000	68000	6.4 U	5.1 U	R
1,2-Dibromo-3-chloropropane	NC	NC	NC	6.4 U	5.1 U	R
1,2-Dibromoethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
1,2-Dichlorobenzene	50000	10000000	5100000	6.4 U	5.1 U	R
1,2-Dichloroethane	1000	24000	6000	6.4 U	5.1 U	4.9 U
1,2-Dichloropropane	NC	43000	10000	6.4 U	5.1 U	4.9 U
1,3-Dichlorobenzene	100000	10000000	5100000	6.4 U	5.1 U	R
1,4-Dichlorobenzene	100000	10000000	570000	6.4 U	5.1 U	R
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	13 U	10 U	4.8 J
2-Hexanone	NC	NC	NC	13 U	10 U	9.9 U
4-Methyl-2-pentanone	50000	1000000	1000000	13 U	10 U	9.9 U
Acetone	100000	1000000	1000000	7.5 J	10 U	4.8 J
Benzene	1000	13000	3000	6.4 U	5.1 U	4.9 U
Bromochloromethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Bromodichloromethane	1000	46000	11000	6.4 U	5.1 U	4.9 U
Bromoform	1000	370000	86000	6.4 U	5.1 U	R

Qualifiers:
J - Estimated
R - Rejected
U - Not detect

400066

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-12 RCK-SSS12-0001 B16B0 4/19/2006 0-1 (ug/kg)	S-12 RCK-SBS12-0204 B16B1 4/19/2006 2-4 (ug/kg)	S-13 RCK-SSS13-0001 B16B4 4/19/2006 0-1 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	6.4 U	5.1 U	4.9 U
Carbon disulfide	NC	NC	NC	6.4 U	5.1 U	4.9 U
Carbon tetrachloride	1000	4000	2000	6.4 U	5.1 U	4.9 U
Chlorobenzene	1000	680000	37000	6.4 U	5.1 U	4.9 U
Chloroethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Chloroform	1000	28000	19000	6.4 U	5.1 U	4.9 U
Chloromethane	10000	1000000	520000	6.4 U	5.1 U	4.9 U
cis-1,2-Dichloroethene	1000	1000000	79000	6.4 U	5.1 U	4.9 U
cis-1,3-Dichloropropene	1000	5000	4000	6.4 U	5.1 U	4.9 U
Cyclohexane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Dibromochloromethane	1000	1000000	110000	6.4 U	5.1 U	4.9 U
Dichlorodifluoromethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Ethylbenzene	100000	1000000	1000000	6.4 U	5.1 U	4.9 U
Isopropylbenzene	NC	NC	NC	6.4 U	5.1 U	4.9 U
(m+p)xylene	67000*	1000000*	410000*	6.4 U	5.1 U	4.9 U
Methyl Acetate	NC	NC	NC	6.4 U	5.1 U	4.9 U
Methyl tert-butyl ether	NC	NC	NC	6.4 U	5.1 U	4.9 U
Methylcyclohexane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Methylene chloride	1000	210000	49000	6.4 U	5.1 U	5.9
o-Xylene	67000*	1000000*	410000*	6.4 U	5.1 U	4.9 U
Styrene	100000	97000	23000	6.4 U	5.1 U	4.9 U
Tetrachloroethene	1000	6000	4000	6.4 U	5.1 U	22 J
Toluene	500000	1000000	1000000	6.4 U	5.1 U	4.9 U
trans-1,2-Dichloroethene	50000	1000000	1000000	6.4 U	5.1 U	4.9 U
Trans-1,3-Dichloropropene	1000	5000	4000	6.4 U	5.1 U	4.9 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400067

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-12 RCK-SSS12-0001 B16B0 4/19/2006 0-1 (ug/kg)	S-12 RCK-SBS12-0204 B16B1 4/19/2006 2-4 (ug/kg)	S-13 RCK-SSS13-0001 B16B4 4/19/2006 0-1 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	6.4 U	5.1 U	4.9 U
Trichlorofluoromethane	NC	NC	NC	6.4 U	5.1 U	4.9 U
Vinyl chloride	10000	7000	2000	6.4 U	5.1 U	4.9 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:

J - Estimated

R - Rejected

U - Non-detect

400068

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-13 RCK-SBS13-0204 B16B5 4/19/2006 2-4 (ug/kg)	S-14 RCK-SSS14-0001 B16A4 4/19/2006 0-1 (ug/kg)	S-14 RCK-SBS14-0204 B16A5 4/19/2006 2-4 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	5 U	5.5 U	4.8 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	5 U	5.5 U	4.8 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	5 U	5.5 U	4.8 U
1,1,2-Trichloroethane	1000	420000	22000	5 U	5.5 U	4.8 U
1,1-Dichloroethane	10000	1000000	570000	5 U	5.5 U	4.8 U
1,1-Dichloroethene	10000	150000	8000	5 U	5.5 U	4.8 U
1,2,3-Trichlorobenzene	NC	NC	NC	5 U	R	4.8 U
1,2,4-Trichlorobenzene	100000	1200000	68000	5 U	R	4.8 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	5 U	R	4.8 U
1,2-Dibromoethane	NC	NC	NC	5 U	5.5 U	4.8 U
1,2-Dichlorobenzene	50000	10000000	5100000	5 U	R	4.8 U
1,2-Dichloroethane	1000	24000	6000	5 U	5.5 U	4.8 U
1,2-Dichloropropane	NC	43000	10000	5 U	5.5 U	4.8 U
1,3-Dichlorobenzene	100000	10000000	5100000	5 U	R	4.8 U
1,4-Dichlorobenzene	100000	10000000	570000	5 U	R	4.8 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	10 U	11 U	9.7 U
2-Hexanone	NC	NC	NC	10 U	11 U	9.7 U
4-Methyl-2-pentanone	50000	1000000	1000000	10 U	11 U	9.7 U
Acetone	100000	1000000	1000000	4.9 J	11 U	5 J
Benzene	1000	13000	3000	5 U	5.5 U	4.8 U
Bromochloromethane	NC	NC	NC	5 U	5.5 U	4.8 U
Bromodichloromethane	1000	46000	11000	5 U	5.5 U	4.8 U
Bromoform	1000	370000	86000	5 U	R	4.8 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400069

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-13 RCK-SBS13-0204 B16B5 4/19/2006 2-4 (ug/kg)	S-14 RCK-SSS14-0001 B16A4 4/19/2006 0-1 (ug/kg)	S-14 RCK-SBS14-0204 B16A5 4/19/2006 2-4 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	5 U	5.5 U	4.8 U
Carbon disulfide	NC	NC	NC	5 U	5.5 U	4.8 U
Carbon tetrachloride	1000	4000	2000	5 U	5.5 U	4.8 U
Chlorobenzene	1000	680000	37000	5 U	5.5 U	4.8 U
Chloroethane	NC	NC	NC	5 U	5.5 U	4.8 U
Chloroform	1000	28000	19000	5 U	5.5 U	4.8 U
Chloromethane	10000	1000000	520000	5 U	5.5 U	4.8 U
cis-1,2-Dichloroethene	1000	1000000	79000	5 U	5.5 U	4.8 U
cis-1,3-Dichloropropene	1000	5000	4000	5 U	5.5 U	4.8 U
Cyclohexane	NC	NC	NC	5 U	5.5 U	4.8 U
Dibromochloromethane	1000	1000000	110000	5 U	5.5 U	4.8 U
Dichlorodifluoromethane	NC	NC	NC	5 U	5.5 U	4.8 U
Ethylbenzene	100000	1000000	1000000	5 U	5.5 U	4.8 U
Isopropylbenzene	NC	NC	NC	5 U	5.5 U	4.8 U
(m+p)xylene	67000*	1000000*	410000*	5 U	5.5 U	4.8 U
Methyl Acetate	NC	NC	NC	5 U	5.5 U	4.8 U
Methyl tert-butyl ether	NC	NC	NC	5 U	5.5 U	4.8 U
Methylcyclohexane	NC	NC	NC	5 U	5.5 U	4.8 U
Methylene chloride	1000	210000	49000	6.6	11	4.8 U
o-Xylene	67000*	1000000*	410000*	5 U	5.5 U	4.8 U
Styrene	100000	97000	23000	5 U	5.5 U	4.8 U
Tetrachloroethene	1000	6000	4000	5 U	150 J	4.8 U
Toluene	500000	1000000	1000000	5 U	5.5 U	4.8 U
trans-1,2-Dichloroethene	50000	1000000	1000000	5 U	5.5 U	4.8 U
Trans-1,3-Dichloropropene	1000	5000	4000	5 U	5.5 U	4.8 U

Qualifiers:
J - Estimated
R - Rejected
U - Not detect

400070

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-13 RCK-SBS13-0204 B16B5 4/19/2006 2-4 (ug/kg)	S-14 RCK-SSS14-0001 B16A4 4/19/2006 0-1 (ug/kg)	S-14 RCK-SBS14-0204 B16A5 4/19/2006 2-4 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	5 U	5.5 U	4.8 U
Trichlorofluoromethane	NC	NC	NC	5 U	5.5 U	4.8 U
Vinyl chloride	10000	7000	2000	5 U	5.5 U	4.8 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400071

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-15 RCK-SSS15-0001 B1699 4/19/2006 0-1 (ug/kg)	S-15 RCK-SBS15-0204 B16A0 4/19/2006 2-4 (ug/kg)	S-16 RCK-SSS16-0001 B16B2 4/19/2006 0-1 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	5.4 U	6 U	5.7 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	5.4 U	6 U	5.7 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	5.4 U	6 U	5.7 U
1,1,2-Trichloroethane	1000	420000	22000	5.4 U	6 U	5.7 U
1,1-Dichloroethane	10000	1000000	570000	5.4 U	6 U	5.7 U
1,1-Dichloroethene	10000	150000	8000	5.4 U	6 U	5.7 U
1,2,3-Trichlorobenzene	NC	NC	NC	5.4 U	6 U	5.7 U
1,2,4-Trichlorobenzene	100000	1200000	68000	5.4 U	6 U	5.7 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	5.4 U	6 U	5.7 U
1,2-Dibromoethane	NC	NC	NC	5.4 U	6 U	5.7 U
1,2-Dichlorobenzene	50000	10000000	5100000	5.4 U	6 U	5.7 U
1,2-Dichloroethane	1000	24000	6000	5.4 U	6 U	5.7 U
1,2-Dichloropropane	NC	43000	10000	5.4 U	6 U	5.7 U
1,3-Dichlorobenzene	100000	10000000	5100000	5.4 U	6 U	5.7 U
1,4-Dichlorobenzene	100000	10000000	570000	5.4 U	6 U	5.7 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	11 U	12 U	11 U
2-Hexanone	NC	NC	NC	11 U	12 U	11 U
4-Methyl-2-pentanone	50000	1000000	1000000	11 U	12 U	11 U
Acetone	100000	1000000	1000000	11 U	12 U	11 U
Benzene	1000	13000	3000	5.4 U	6 U	5.7 U
Bromochloromethane	NC	NC	NC	5.4 U	6 U	5.7 U
Bromodichloromethane	1000	46000	11000	5.4 U	6 U	5.7 U
Bromoform	1000	370000	86000	5.4 U	6 U	5.7 U

Qualifiers:
J - Estimated
R - Rejected
U - Not detect

400072

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-15 RCK-SSS15-0001 B1699 4/19/2006 0-1 (ug/kg)	S-15 RCK-SBS15-0204 B16A0 4/19/2006 2-4 (ug/kg)	S-16 RCK-SSS16-0001 B16B2 4/19/2006 0-1 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	5.4 U	6 U	5.7 U
Carbon disulfide	NC	NC	NC	5.4 U	6 U	5.7 U
Carbon tetrachloride	1000	4000	2000	5.4 U	6 U	5.7 U
Chlorobenzene	1000	680000	37000	5.4 U	6 U	5.7 U
Chloroethane	NC	NC	NC	5.4 U	6 U	5.7 U
Chloroform	1000	28000	19000	5.4 U	6 U	5.7 U
Chloromethane	10000	1000000	520000	5.4 U	6 U	5.7 U
cis-1,2-Dichloroethene	1000	1000000	79000	5.4 U	6 U	5.7 U
cis-1,3-Dichloropropene	1000	5000	4000	5.4 U	6 U	5.7 U
Cyclohexane	NC	NC	NC	5.4 U	6 U	5.7 U
Dibromochloromethane	1000	1000000	110000	5.4 U	6 U	5.7 U
Dichlorodifluoromethane	NC	NC	NC	5.4 U	6 U	5.7 U
Ethylbenzene	100000	1000000	1000000	5.4 U	6 U	5.7 U
Isopropylbenzene	NC	NC	NC	5.4 U	6 U	5.7 U
(m+p)xylene	67000*	1000000*	410000*	5.4 U	6 U	5.7 U
Methyl Acetate	NC	NC	NC	5.4 U	6 U	5.7 U
Methyl tert-butyl ether	NC	NC	NC	5.4 U	6 U	5.7 U
Methylcyclohexane	NC	NC	NC	5.4 U	6 U	5.7 U
Methylene chloride	1000	210000	49000	7.6	6 U	5.7 U
o-Xylene	67000*	1000000*	410000*	5.4 U	6 U	5.7 U
Styrene	100000	97000	23000	5.4 U	6 U	5.7 U
Tetrachloroethene	1000	6000	4000	2.7 J	6 U	5.7 U
Toluene	500000	1000000	1000000	5.4 U	6 U	5.7 U
trans-1,2-Dichloroethene	50000	1000000	1000000	5.4 U	6 U	5.7 U
Trans-1,3-Dichloropropene	1000	5000	4000	5.4 U	6 U	5.7 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400073

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-15 RCK-SSS15-0001 B1699 4/19/2006 0-1 (ug/kg)	S-15 RCK-SBS15-0204 B16A0 4/19/2006 2-4 (ug/kg)	S-16 RCK-SSS16-0001 B16B2 4/19/2006 0-1 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	5.4 U	6 U	5.7 U
Trichlorofluoromethane	NC	NC	NC	5.4 U	6 U	5.7 U
Vinyl chloride	10000	7000	2000	5.4 U	6 U	5.7 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:

J - Estimated

R - Rejected

U - Non-detect

400074

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-16 RCK-SBS16-0204 B16B3 4/19/2006 2-4 (ug/kg)	S-17 RCK-SSS17-0001 B16B6 4/19/2006 0-1 (ug/kg)	S-17 RCK-SBS17-0204 B16B7 4/19/2006 2-4 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	5.2 U	6.2 U	5.2 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	5.2 U	6.2 U	5.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
1,1,2-Trichloroethane	1000	420000	22000	5.2 U	6.2 U	5.2 U
1,1-Dichloroethane	10000	1000000	570000	5.2 U	6.2 U	5.2 U
1,1-Dichloroethene	10000	150000	8000	5.2 U	6.2 U	5.2 U
1,2,3-Trichlorobenzene	NC	NC	NC	5.2 U	R	5.2 U
1,2,4-Trichlorobenzene	100000	1200000	68000	5.2 U	R	5.2 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	5.2 U	R	5.2 U
1,2-Dibromoethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
1,2-Dichlorobenzene	50000	10000000	5100000	5.2 U	R	5.2 U
1,2-Dichloroethane	1000	24000	6000	5.2 U	6.2 U	5.2 U
1,2-Dichloropropane	NC	43000	10000	5.2 U	6.2 U	5.2 U
1,3-Dichlorobenzene	100000	10000000	5100000	5.2 U	R	5.2 U
1,4-Dichlorobenzene	100000	10000000	570000	5.2 U	R	5.2 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	10 U	12 U	10 U
2-Hexanone	NC	NC	NC	10 U	12 U	10 U
4-Methyl-2-pentanone	50000	1000000	1000000	10 U	12 U	10 U
Acetone	100000	1000000	1000000	10 U	5.7 J	5.2 J
Benzene	1000	13000	3000	5.2 U	6.2 U	5.2 U
Bromochloromethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Bromodichloromethane	1000	46000	11000	5.2 U	6.2 U	5.2 U
Bromoform	1000	370000	86000	5.2 U	R	5.2 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400075

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-16 RCK-SBS16-0204 B16B3 4/19/2006 2-4 (ug/kg)	S-17 RCK-SSS17-0001 B16B6 4/19/2006 0-1 (ug/kg)	S-17 RCK-SBS17-0204 B16B7 4/19/2006 2-4 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	5.2 U	6.2 U	5.2 U
Carbon disulfide	NC	NC	NC	5.2 U	6.2 U	5.2 U
Carbon tetrachloride	1000	4000	2000	5.2 U	6.2 U	5.2 U
Chlorobenzene	1000	680000	37000	5.2 U	6.2 U	5.2 U
Chloroethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Chloroform	1000	28000	19000	5.2 U	6.2 U	5.2 U
Chloromethane	10000	1000000	520000	5.2 U	6.2 U	5.2 U
cis-1,2-Dichloroethene	1000	1000000	79000	5.2 U	6.2 U	5.2 U
cis-1,3-Dichloropropene	1000	5000	4000	5.2 U	6.2 U	5.2 U
Cyclohexane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Dibromochloromethane	1000	1000000	110000	5.2 U	6.2 U	5.2 U
Dichlorodifluoromethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Ethylbenzene	100000	1000000	1000000	5.2 U	6.2 U	5.2 U
Isopropylbenzene	NC	NC	NC	5.2 U	6.2 U	5.2 U
(m+p)xylene	67000*	1000000*	410000*	5.2 U	6.2 U	5.2 U
Methyl Acetate	NC	NC	NC	5.2 U	6.2 U	5.2 U
Methyl tert-butyl ether	NC	NC	NC	5.2 U	6.2 U	5.2 U
Methylcyclohexane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Methylene chloride	1000	210000	49000	5.2 U	9.3	2.7 J
o-Xylene	67000*	1000000*	410000*	5.2 U	6.2 U	5.2 U
Styrene	100000	97000	23000	5.2 U	6.2 U	5.2 U
Tetrachloroethene	1000	6000	4000	5.2 U	15 J	5.2 U
Toluene	500000	1000000	1000000	5.2 U	6.2 U	5.2 U
trans-1,2-Dichloroethene	50000	1000000	1000000	5.2 U	6.2 U	5.2 U
Trans-1,3-Dichloropropene	1000	5000	4000	5.2 U	6.2 U	5.2 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400076

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-16 RCK-SBS16-0204 B16B3 4/19/2006 2-4 (ug/kg)	S-17 RCK-SSS17-0001 B16B6 4/19/2006 0-1 (ug/kg)	S-17 RCK-SBS17-0204 B16B7 4/19/2006 2-4 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	5.2 U	6.2 U	5.2 U
Trichlorofluoromethane	NC	NC	NC	5.2 U	6.2 U	5.2 U
Vinyl chloride	10000	7000	2000	5.2 U	6.2 U	5.2 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:

J - Estimated

R - Rejected

U - Non-detect

400077

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-18 RCK-SSS18-0001 B16A6 4/19/2006 0-1 (ug/kg)	S-18 RCK-SBS18-0204 B16A7 4/19/2006 2-4 (ug/kg)	S-19 RCK-SSS19-0001 B16A8 4/19/2006 0-1 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	4.7 U	5.4 U	4.7 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	4.7 U	5.4 U	4.7 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
1,1,2-Trichloroethane	1000	420000	22000	4.7 U	5.4 U	4.7 U
1,1-Dichloroethane	10000	1000000	570000	4.7 U	5.4 U	4.7 U
1,1-Dichloroethene	10000	150000	8000	4.7 U	5.4 U	4.7 U
1,2,3-Trichlorobenzene	NC	NC	NC	4.7 U	5.4 U	4.7 U
1,2,4-Trichlorobenzene	100000	1200000	68000	4.7 U	5.4 U	4.7 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	4.7 U	5.4 U	4.7 U
1,2-Dibromoethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
1,2-Dichlorobenzene	50000	10000000	5100000	4.7 U	5.4 U	4.7 U
1,2-Dichloroethane	1000	24000	6000	4.7 U	5.4 U	4.7 U
1,2-Dichloropropane	NC	43000	10000	4.7 U	5.4 U	4.7 U
1,3-Dichlorobenzene	100000	10000000	5100000	4.7 U	5.4 U	4.7 U
1,4-Dichlorobenzene	100000	10000000	570000	4.7 U	5.4 U	4.7 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	9.4 U	11 U	9.5 U
2-Hexanone	NC	NC	NC	9.4 U	11 U	9.5 U
4-Methyl-2-pentanone	50000	1000000	1000000	9.4 U	11 U	9.5 U
Acetone	100000	1000000	1000000	5.7 J	5.2 J	9.5 U
Benzene	1000	13000	3000	4.7 U	5.4 U	4.7 U
Bromochloromethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Bromodichloromethane	1000	46000	11000	4.7 U	5.4 U	4.7 U
Bromoform	1000	370000	86000	4.7 U	5.4 U	4.7 U

Qualifiers:
J - Estimated
R - Rejected
U - Not detect

400078

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-18 RCK-SSS18-0001 B16A6 4/19/2006 0-1 (ug/kg)	S-18 RCK-SBS18-0204 B16A7 4/19/2006 2-4 (ug/kg)	S-19 RCK-SSS19-0001 B16A8 4/19/2006 0-1 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	4.7 U	5.4 U	4.7 U
Carbon disulfide	NC	NC	NC	4.7 U	5.4 U	4.7 U
Carbon tetrachloride	1000	4000	2000	4.7 U	5.4 U	4.7 U
Chlorobenzene	1000	680000	37000	4.7 U	5.4 U	4.7 U
Chloroethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Chloroform	1000	28000	19000	4.7 U	5.4 U	4.7 U
Chloromethane	10000	1000000	520000	4.7 U	5.4 U	4.7 U
cis-1,2-Dichloroethene	1000	1000000	79000	4.7 U	5.4 U	4.7 U
cis-1,3-Dichloropropene	1000	5000	4000	4.7 U	5.4 U	4.7 U
Cyclohexane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Dibromochloromethane	1000	1000000	110000	4.7 U	5.4 U	4.7 U
Dichlorodifluoromethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Ethylbenzene	100000	1000000	1000000	4.7 U	5.4 U	4.7 U
Isopropylbenzene	NC	NC	NC	4.7 U	5.4 U	4.7 U
(m+p)xylene	67000*	1000000*	410000*	4.7 U	5.4 U	4.7 U
Methyl Acetate	NC	NC	NC	4.7 U	5.4 U	4.7 U
Methyl tert-butyl ether	NC	NC	NC	4.7 U	5.4 U	4.7 U
Methylcyclohexane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Methylene chloride	1000	210000	49000	8.4	3.4 J	2.8 J
o-Xylene	67000*	1000000*	410000*	4.7 U	5.4 U	4.7 U
Styrene	100000	97000	23000	4.7 U	5.4 U	4.7 U
Tetrachloroethene	1000	6000	4000	32	4 J	4.7 U
Toluene	500000	1000000	1000000	4.7 U	5.4 U	4.7 U
trans-1,2-Dichloroethene	50000	1000000	1000000	4.7 U	5.4 U	4.7 U
Trans-1,3-Dichloropropene	1000	5000	4000	4.7 U	5.4 U	4.7 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400079

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-18 RCK-SSS18-0001 B16A6 4/19/2006 0-1 (ug/kg)	S-18 RCK-SBS18-0204 B16A7 4/19/2006 2-4 (ug/kg)	S-19 RCK-SSS19-0001 B16A8 4/19/2006 0-1 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	4.7 U	5.4 U	4.7 U
Trichlorofluoromethane	NC	NC	NC	4.7 U	5.4 U	4.7 U
Vinyl chloride	10000	7000	2000	4.7 U	5.4 U	4.7 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:

J - Estimated

R - Rejected

U - Non-detect

400080

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-19 RCK-SBS19-0204 B16A9 4/19/2006 2-4 (ug/kg)	S-20 RCK-SSS20-0001 B1697 4/19/2006 0-1 (ug/kg)	S-20 RCK-SBS20-0204 B1698 4/19/2006 2-4 (ug/kg)
Constituent						
1,1,1-Trichloroethane	50000	1000000	210000	5.1 U	5.3 U	5.6 U
1,1,2,2-Tetrachloroethane	1000	70000	34000	5.1 U	5.3 U	5.6 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
1,1,2-Trichloroethane	1000	420000	22000	5.1 U	5.3 U	5.6 U
1,1-Dichloroethane	10000	1000000	570000	5.1 U	5.3 U	5.6 U
1,1-Dichloroethene	10000	150000	8000	5.1 U	5.3 U	5.6 U
1,2,3-Trichlorobenzene	NC	NC	NC	5.1 U	5.3 U	5.6 U
1,2,4-Trichlorobenzene	100000	1200000	68000	5.1 U	5.3 U	5.6 U
1,2-Dibromo-3-chloropropane	NC	NC	NC	5.1 U	5.3 U	5.6 U
1,2-Dibromoethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
1,2-Dichlorobenzene	50000	10000000	5100000	5.1 U	5.3 U	5.6 U
1,2-Dichloroethane	1000	24000	6000	5.1 U	5.3 U	5.6 U
1,2-Dichloropropane	NC	43000	10000	5.1 U	5.3 U	5.6 U
1,3-Dichlorobenzene	100000	10000000	5100000	5.1 U	5.3 U	5.6 U
1,4-Dichlorobenzene	100000	10000000	570000	5.1 U	5.3 U	5.6 U
1,4-Dioxane	NC	NC	NC	R	R	R
2-Butanone	50000	1000000	1000000	10 U	11 U	11 U
2-Hexanone	NC	NC	NC	10 U	11 U	11 U
4-Methyl-2-pentanone	50000	1000000	1000000	10 U	11 U	11 U
Acetone	100000	1000000	1000000	10 U	11 U	11 U
Benzene	1000	13000	3000	5.1 U	5.3 U	5.6 U
Bromochloromethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Bromodichloromethane	1000	46000	11000	5.1 U	5.3 U	5.6 U
Bromoform	1000	370000	86000	5.1 U	5.3 U	5.6 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400081

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-19 RCK-SBS19-0204 B16A9 4/19/2006 2-4 (ug/kg)	S-20 RCK-SSS20-0001 B1697 4/19/2006 0-1 (ug/kg)	S-20 RCK-SBS20-0204 B1698 4/19/2006 2-4 (ug/kg)
Constituent						
Bromomethane	1000	1000000	79000	5.1 U	5.3 U	5.6 U
Carbon disulfide	NC	NC	NC	5.1 U	5.3 U	5.6 U
Carbon tetrachloride	1000	4000	2000	5.1 U	5.3 U	5.6 U
Chlorobenzene	1000	680000	37000	5.1 U	5.3 U	5.6 U
Chloroethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Chloroform	1000	28000	19000	5.1 U	5.3 U	5.6 U
Chloromethane	10000	1000000	520000	5.1 U	5.3 U	5.6 U
cis-1,2-Dichloroethene	1000	1000000	79000	5.1 U	5.3 U	5.6 U
cis-1,3-Dichloropropene	1000	5000	4000	5.1 U	5.3 U	5.6 U
Cyclohexane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Dibromochloromethane	1000	1000000	110000	5.1 U	5.3 U	5.6 U
Dichlorodifluoromethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Ethylbenzene	100000	1000000	1000000	5.1 U	5.3 U	5.6 U
Isopropylbenzene	NC	NC	NC	5.1 U	5.3 U	5.6 U
(m+p)xylene	67000*	1000000*	410000*	5.1 U	5.3 U	5.6 U
Methyl Acetate	NC	NC	NC	5.1 U	5.3 U	5.6 U
Methyl tert-butyl ether	NC	NC	NC	5.1 U	5.3 U	5.6 U
Methylcyclohexane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Methylene chloride	1000	210000	49000	2.8 J	5.3 U	5.6 U
o-Xylene	67000*	1000000*	410000*	5.1 U	5.3 U	5.6 U
Styrene	100000	97000	23000	5.1 U	5.3 U	5.6 U
Tetrachloroethene	1000	6000	4000	7	5.3 U	5.6 U
Toluene	500000	1000000	1000000	5.1 U	5.3 U	5.6 U
trans-1,2-Dichloroethene	50000	1000000	1000000	5.1 U	5.3 U	5.6 U
Trans-1,3-Dichloropropene	1000	5000	4000	5.1 U	5.3 U	5.6 U

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400082

Table 1-1
Rockaway Borough Wellfield Site
Summary of April 2006 Soil Sampling Results

Site ID TtEC Sample ID EPA Sample ID Sample Date Depth Interval (feet) Units	NJDEP Soil Cleanup Criteria Impact to Groundwater (ug/kg)	NJDEP Soil Cleanup Criteria Non-Residential Direct Contact (ug/kg)	NJDEP Soil Cleanup Criteria Residential Direct Contact (ug/kg)	S-19 RCK-SBS19-0204 B16A9 4/19/2006 2-4 (ug/kg)	S-20 RCK-SSS20-0001 B1697 4/19/2006 0-1 (ug/kg)	S-20 RCK-SBS20-0204 B1698 4/19/2006 2-4 (ug/kg)
Constituent						
Trichloroethene	1000	54000	23000	5.1 U	5.3 U	5.6 U
Trichlorofluoromethane	NC	NC	NC	5.1 U	5.3 U	5.6 U
Vinyl chloride	10000	7000	2000	5.1 U	5.3 U	5.6 U

Notes:

Values that exceeded New Jersey soil criterias are in **BOLD**.

* = Criteria value corresponds to the value for total xylenes.

References:

NJDEP Criteria from Soil Cleanup Criteria, NJAC 7:26D, last revised 12 May 1999.

Qualifiers:
J - Estimated
R - Rejected
U - Non-detect

400083

Table 2-1
Rockaway Borough Wellfield Superfund Site
Chemical-Specific Applicable or Relevant and Appropriate
Requirements (ARARs) and Requirements To Be Considered (TBCs)

ARAR / TBC Type	Requirement	Citation	Description	Comments
FEDERAL	Resource Conservation and Recovery Act (RCRA) Groundwater Protection Standards	40 CFR 264.94	Maximum contaminant concentrations for groundwater protection at hazardous waste management facilities.	Potential ARAR for groundwater cleanup and replacement standards.
STATE	Soil Cleanup Criteria	State Guidance	Identifies restricted (non-residential) and unrestricted (residential) soil cleanup guidelines, as well as guidelines for protection of groundwater.	Potential TBC for contaminants in on-site soils.
STATE	Vapor Intrusion Guidance	State Guidance	Identifies health-based, residential and nonresidential groundwater, indoor air, and soil gas screening values and reporting limits.	Potential TBC for vapor intrusion pathway. Analyte concentrations in some soil gas samples exceed screening values.

Table 2-2
Rockaway Borough Wellfield Superfund Site
Location-Specific Potential Applicable or Relevant and Appropriate
Requirements (ARARs) and Requirements To Be Considered (TBCs)

ARAR / TBC Type	Requirement	Citation	Description	Comments
<i>FEDERAL</i>	Resource Conservation and Recovery Act (RCRA) Regulations – Location Standards	40 CFR 264.18	Regulates the design, construction, operation, and maintenance of hazardous waste management facilities within the 100-year floodplain.	Potential ARAR for on-site treatment, storage, or disposal of hazardous waste.
<i>FEDERAL</i>	National Historic Preservation Act	36 CFR 800	Federal agencies must take into consideration the impacts of their undertakings on properties that are listed in, nominated to, and eligible for the National Register of Historic Places.	Potential ARAR for site activities that may affect the Morris Canal, a historic property listed in the National Register of Historic Places.

Table 2-3 (Sheet 1 of 2)
Rockaway Borough Wellfield Superfund Site
Action-Specific Potential Applicable or Relevant and Appropriate
Requirements (ARARs) and Requirements To Be Considered (TBCs)

ARAR / TBC Type	Requirement	Citation	Description	Comments
FEDERAL	Hazardous Waste Generation	40 CFR 262	Specifies requirements for hazardous waste packaging, labeling, manifesting, and storage.	Potential ARAR for on-site storage of hazardous waste.
	Transportation of Hazardous Waste	40 CFR 263	Specifies requirements for transporters of hazardous waste to obtain an EPA identification number, comply with manifest procedures, and spill response.	Potential ARAR for the use of transporters for off-site disposal of hazardous waste.
	Treatment, Storage, and Disposal of Hazardous Waste	40 CFR 264/265	Specifies requirements for the operation of hazardous waste treatment, storage, and disposal facilities.	Potential ARAR for on-site hazardous waste treatment and storage and disposal activities.
	Land Disposal Restrictions	40 CFR 268	Sets out prohibitions and establishes standards for the land disposal of hazardous wastes.	Potential ARAR for on-site hazardous waste disposal activities.
	National Ambient Air Quality Standards - Particulates	40 CFR 50	Establishes maximum concentrations for particulates and fugitive dust emissions.	Potentially applicable for on-site activities which would generate particulate emissions.
	United States Department of Transportation (USDOT) Hazardous Materials Transportation Regulations	49 CFR 171-180	Establishes classification, packaging, and labeling requirements for shipments of hazardous materials.	Potentially applicable for the preparation and off-site shipment of hazardous materials generated on-site.
	EPA Test Methods for Evaluation of Solid Waste	SW-846	Establishes analytical requirements for testing and evaluating solid/hazardous wastes.	Potential TBC for testing waste samples.
STATE	Hazardous Waste Management Regulations	NJAC 7:26G	Provides requirements for the generation, accumulation, on-site management, and transportation of hazardous waste.	Potential ARAR for on-site management and disposal of hazardous waste.
	Air Quality Regulations	NJAC 7:27	Provides requirements applicable to air pollution sources.	Potential ARAR for the generation and emission of air pollutants.

Table 2-3 (Sheet 2 of 2)
Rockaway Borough Wellfield Superfund Site
Action-Specific Potential Applicable or Relevant and Appropriate
Requirements (ARARs) and Requirements To Be Considered (TBCs)

ARAR / TBC Type	Requirement	Citation	Description	Comments
<i>STATE cont'd</i>	Industrial Site Recovery Act	NJSA 13:1K	Requires soil remediation standards for human carcinogens in excess of established standards.	Potential ARAR for setting soil remediation criteria where more stringent than federal risk standards.
	Soil Erosion and Sediment Control	NJSA 4:24	Requires the implementation of soil erosion and sediment control measures for activities disturbing more than 5,000 square feet of surface area of land..	Potential ARAR for site activities involving excavation, grading, or other soil disturbance activities.

Table 2-4 (Sheet 1 of 2)
Rockaway Borough Wellfield Superfund Site
General Response Actions, Technology Types, and Process Options for Soils

General Response Actions	Remedial Technology Types	Process Options
1. No Action	- No Action	- No process options
2. Limited Action	- Institutional Controls	- Inform local officials and hold public meetings - Implement institutional controls (e.g. deed notice)
3. Containment	- Containment	- Soil Cap - Clay Cap - Asphalt Cap - Multimedia Cap
4. Removal	<u>Removal Technologies</u> - Excavation	- Excavation of soils above action levels
5. Treatment	<u>Treatment Technologies</u> - Physical Treatment - Chemical Treatment - Biological Treatment - Thermal Treatment	- Solidification / Stabilization - Soil Washing - Lime Neutralization - Chemical Oxidation - Chemical Dehalogenation - Chemical / Solvent Extraction - Aerobic Biodegradation - Anaerobic Biodegradation - Thermal Desorption - Incineration - Pyrolysis

Table 2-4 (Sheet 2 of 2)
Rockaway Borough Wellfield Superfund Site
General Response Actions, Technology Types, and Process Options for Soils

General Response Actions	Remedial Technology Types	Process Options
6. Disposal	<ul style="list-style-type: none"> - <i>In Situ</i> Treatment 	<ul style="list-style-type: none"> - <i>In Situ</i> Biodegradation - <i>In Situ</i> Oxidation - <i>In Situ</i> Solidification / Stabilization - <i>In Situ</i> Vitrification - <i>In Situ</i> Soil Washing - <i>In Situ</i> Hot Air / Steam Injection - <i>In Situ</i> Soil Vapor Extraction (SVE) - Phytoremediation
	<p><u>Disposal Technologies</u></p> <ul style="list-style-type: none"> - Disposal 	<ul style="list-style-type: none"> - On-Site Reuse - On-Site Landfill - Off-Site Disposal - Reuse / Recycling

Table 2-5 (Sheet 1 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
1. No Action	- No Action	No actions taken	YES	Provides baseline against which other remedial technologies can be compared. Required for consideration by CERCLA.
2. Limited Action	- Inform Public & Hold Local Meetings	Public awareness programs are developed and implemented.	YES	Reduces likelihood of exposure through public awareness program.
	- Implement Institutional Controls	Intermittent site reviews and implementation of a Health & Safety Plan (HASP).	YES	Reduces likelihood of exposure to soil and inhalation of soil/dust.
3. Containment	- Soil Cap	Install clean soil over contaminated soil to prevent direct contact with contaminants.	NO	Only addresses direct contact exposure, which is not a concern.
	- Clay Cap	Install low permeability material over contaminated soil to physically isolate contaminant source and potentially reduce the leaching of contaminants to groundwater.	YES	Low permeability bentonite layer is effective for reducing infiltration and contaminant migration susceptible to erosion and cracking. Maintenance is required.
	- Asphalt Cap	Install asphalt over contaminated soil to physically isolate contaminant source and potentially reduce the leaching of contaminants to groundwater.	YES	Low susceptibility to erosion, highly effective in preventing direct contact and reduces infiltration and contaminant migration. Maintenance is required.
	- Multimedia Cap	Install a combination of the above capping options to prevent contact and/or isolate the contaminant source.	NO	Combination of different capping options allows for the maximization of effective options. Not feasible to install due to the limited extent of contamination and developed nature of the area.
4. Removal	- Excavation	Physical removal of contaminated soil with the intention of subsequent treatment and/or disposal.	YES	Services, materials, and equipment are well developed and readily available.

Table 2-5 (Sheet 2 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
5. Treatment	<u>Physical Treatment</u>			
	- Solidification / Stabilization	Contaminated soil is converted into a stable cement-type matrix so that contaminants are bound and become immobile.	NO	Although the technology is proven and commonplace, bench testing is required to identify the site-specific appropriate (cementitious) additives and dosage rates, particularly for VOCs. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	- Soil Washing	Impacted material is processed in a treatment unit for removal of organic constituents.	NO	Significant feedstock preparation is necessary and large volumes of aqueous waste are generated and would require further treatment. Limited effectiveness for low solubility contaminants. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	<u>Chemical Treatment</u>			
	- Lime Neutralization	Addition of lime neutralizes acids in the soil.	NO	Only treats a small portion of site contaminants; some difficulty in maintaining the correct pH. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	- Chemical Oxidation	An oxidizing agent, such as hydrogen peroxide, reacts with the soil and breaks down the organic constituents into carbon dioxide and water.	NO	Bench-scale testing and field pilot studies are necessary to determine the operational conditions for this type of remediation. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.

Table 2-5 (Sheet 3 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
	<u>Chemical Treatment (Cont'd)</u>			
	- Chemical Dehalogenation	Reagents are added to soils contaminated with halogenated organics. The Dehalogenation process is achieved by either the replacement of the halogen molecules or the decomposition and partial volatilization of the contaminants.	NO	Process design must assure sufficient contact. Process is less effective against halogenated VOCs. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	- Chemical / Solvent Extraction	Contaminated soil and extractant are mixed in an extractor, thereby dissolving the contaminants. The extracted solution is then placed in a separator, where the contaminants and extractant are separated for treatment and further use.	NO	Capital costs can be relatively high. Process design must assure sufficient contact. Organically bound metals can be extracted along with target organic pollutants, which restricts handling of the residuals. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	<u>Biological Treatment</u>			
	- Aerobic biodegradation	Microbes or selectively adapted bacteria, nutrients, oxygen, and water are used to degrade organic compounds in soil.	NO	May take several years for cleanup. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	- Anaerobic biodegradation	Microbes or selectively adapted bacteria and nutrients are used to degrade organic compounds in the absence of oxygen.	NO	May take several years for cleanup. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	<u>Thermal Treatment</u>			
	- Thermal Desorption	A thermal stripping process in which direct or indirect heating methods volatilize organics from the soil.	NO	Desorption costs can be high. Organics are thermally separated from soil. Metals remain in the impacted material and require further treatment. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.

Table 2-5 (Sheet 4 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
	- Incineration	Organic contaminants in soil are thermally destroyed at very high temperatures.	NO	High capital cost incurred; due to stringent regulations, there is a lengthy and difficult permitting process. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	- Pyrolysis	Cracking and decomposition of organic constituents in the absence of oxygen.	NO	Not feasible for streams with high concentrations of metals or inorganics. Not a conventional full-scale technology. The small quantity of soil and limited space available for on-site treatment make this technology not feasible.
	<u><i>In Situ Treatment</i></u>			
	- <i>In Situ</i> Biodegradation	Microbes and oxygen are injected into subsurface soil to degrade organic compounds.	NO	Limited effectiveness for PCE removal and does not address inorganics.
	- <i>In Situ</i> Oxidation	A chemical reagent is injected into the soil to break down organic constituents into carbon dioxide and water.	YES	Effective for PCE removal.
	- <i>In Situ</i> Solidification / Stabilization	Contaminated soils are converted in-place into a stable matrix, making the contaminants immobile. Stabilizing agents (silicates) are injected and mixed with the soil.	YES	Appropriate for and effective in immobilizing site contaminants and preventing exposure; disposal is not needed. Field testing is required to identify the appropriate site-specific additives and dosage rates. Pilot tests may also be necessary to determine the effectiveness for treating VOCs.
	- <i>In Situ</i> Vitrification	A solidification method that employs heat (up to 1200°C) to melt and convert waste materials into glass. The high temperatures destroy organic constituents with few by-products.	NO	Requires large power requirements. Typically only used for radiological encapsulation.

Table 2-5 (Sheet 5 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
	<u>In Situ Treatment (Cont'd)</u>			
	- <i>In Situ</i> Soil Washing	A surfactant is injected into the impacted material. The sorbed contaminants are mobilized into solution and extracted via subsurface wells.	NO	Ability of the washing agent to make contact with contaminants is negatively impacted by the subsurface soil heterogeneity. Further treatment needed for the extracted aqueous (reagent) waste. Limited effectiveness for low solubility contaminants. Control is difficult.
	- <i>In Situ</i> Hot Air / Steam Injection	Hot air or steam is injected below the contaminated zone to heat up contaminated soil. The heating enhances the release of contaminants from the soil matrix. Some VOCs are stripped from the contaminated zone and brought to the surface through soil vapor extraction.	YES	Soil that is tight or has high moisture content has a reduced permeability to air, hindering operation and requiring more energy input to increase vacuum and temperature. High organic content has a high sorption capacity of VOCs, which results in reduced removal rates. Heterogeneity will inhibit thermal contact.
	- <i>In Situ</i> Soil Vapor Extraction	Vacuum is applied through extraction wells to create a pressure/concentration gradient that induces gas-phase volatiles to be removed from soil through extraction wells.	YES	Presumptive remedy for VOCs.
	- Phytoremediation	Process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil. The mechanisms for phytoremediation include enhanced rhizosphere bioremediation, phytoextraction, phyto-degradation, and phyto-stabilization.	NO	Can transfer contaminants across media (e.g., from soil to air). Not effective at depth.
6. Disposal	- On-Site Reuse	Impacted soil is excavated, treated (if necessary), and reused as backfill on-site in the excavated areas.	NO	Material to be reused must meet geotechnical requirements and regulatory standards. On-site treatment to meet reuse criteria not feasible due to site conditions.

400094

Table 2-5 (Sheet 6 of 6)
Rockaway Borough Wellfield Superfund Site
Initial Screening of Remedial Technologies and Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Description	Technically Feasible	Screening Comments
	- On-Site Landfill	Impacted soil is excavated and then disposed in a landfill which is constructed on-site, including a liner system, leachate collection and treatment, and a multi-layer cap.	NO	An on-site landfill must meet rigorous regulatory requirements. Requires highly detailed engineering controls. The small quantity of soil and limited space available for an on-site landfill make this technology not feasible.
	- Off-Site Disposal	Contaminated material is transported to a regulated facility for treatment, if necessary, prior to disposal (landfill).	YES	Off-site disposal is a viable option for excavated soil and/or treatment residuals.
	- Reuse / Recycling	Contaminated soil is transported to a facility that can treat the material and make it suitable for reuse.	YES	Reuse of soil after off-site treatment is a viable option for excavated soil.

Table 2-6
Rockaway Borough Wellfield Superfund Site
Evaluation of Process Options for Soils

General Response Actions	Remedial Technology Types and Process Options	Effectiveness	Implementability	Cost
1. No Action	- No Action*	- Does not meet RAO	- Easy	- Very low cost
2. Limited Action	- Inform Public & Hold Local Meetings*	- Does not meet RAO - Prevents exposure to site contaminants - Protects workers during future activities	- Easy	- Low to moderate cost
	- Implement Institutional Controls*	- Does not meet RAO - Prevents exposure to site contaminants - Protects workers during future activities	- Easy	- Low to moderate cost
3. Containment	- Clay Cap - Asphalt Cap	- Prevents exposure to site contaminants - Minimizes infiltration - Prevents exposure to site contaminants - Minimizes infiltration	- Easy - Easy and consistent w/ current conditions	- Moderate cost - Moderate cost
4. Removal	- Excavation*	- Effective for contaminant removal - Subsequent treatment / disposal needed	- Easy at shallow depth - Moderate at depth	- Low cost (depending on depth)
5. Treatment	- <i>In Situ</i> Oxidation - <i>In Situ</i> Solidification/Stabilization - <i>In Situ</i> Hot Air/Steam Injection - <i>In Situ</i> Soil Vapor Extraction*	- Effective for destruction of PCE - Immobilizes contaminants - Testing required for PCE effectiveness - Effective for removal of PCE - Not effective for metals - Effective for removal of PCE - Not effective for metals	- Moderate - Moderate - No disposal needed - Very disruptive - Moderate - Easy	- Low cost - High cost - Moderate cost - Low cost
6. Disposal	- Off-Site Disposal* - Reuse / Recycling	- Effective for final disposal - Soil containing elevated metals concentrations may not be suitable for reuse or recycling	- Easy - Requires transport - Easy - Requires transport	- Moderate cost - Low to moderate cost

* Representative process options selected for development of remedial alternative.

400096

Table 4-1 (Sheet 1 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
Overall Protection of Human Health and the Environment				
	Not protective of human health or the environment.	No remediation of soil; however, potential risks may be reduced by institutional controls.	Removal and treatment of PCE-contaminated soil would mitigate potential source of groundwater contamination.	Removal of PCE-contaminated soil would mitigate potential source of groundwater contamination.
Compliance with ARARs				
- <i>Compliance with Chemical-Specific ARARs</i>	Would not comply with chemical-specific TBCs (<i>i.e.</i> , NJDEP SCC).	Would not comply with chemical-specific TBCs (<i>i.e.</i> , NJDEP SCC).	Hot Spot Excavation and <i>in situ</i> treatment would comply with chemical-specific TBCs, except for inaccessible areas beneath buildings. The SVE contingency plan would treat soil beneath Lusardi's Cleaners.	Excavation would comply with chemical-specific TBCs, except for inaccessible areas beneath buildings. The SVE contingency plan would treat the soil beneath Lusardi's Cleaners.
- <i>Compliance with Location-Specific ARARs</i>	Would not trigger location-specific ARARs.	Would not trigger location-specific ARARs.	Location-specific ARARs are not expected to be triggered as excavation and treatment is not planned in sensitive environments.	Location-specific ARARs are not expected to be triggered as excavation is not planned in sensitive environments.
- <i>Compliance with Action-Specific ARARs</i>	Would not trigger action-specific ARARs.	Would not trigger action-specific ARARs.	Excavation and <i>in situ</i> treatment would be performed in accordance with action-specific ARARs.	Excavation with Off-Site Disposal would be performed in accordance with action-specific ARARs.
Long-Term Effectiveness				
- <i>Magnitude of Residual Risk</i>	The Site does not pose unacceptable risks to human health, but may be a potential ongoing source for groundwater contamination	The Site does not pose unacceptable risks to human health, but may be a potential ongoing source for groundwater contamination	Immediate reduction of potential source of groundwater contamination. There would be the potential for residual contamination to remain	Immediate reduction of potential source of groundwater contamination and potential for vapor intrusion. There would be the

Table 4-1 (Sheet 2 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
	and may be a potential source of indoor air exposure. These risks would persist.	and may be a potential source of indoor air exposure. These risks would persist.	outside the area of influence for the SVE system and/or under existing building foundations. These risks are expected to be minimal in comparison to present risks. The risks would be reduced with the contingency SVE treatment.	potential for residual contamination to remain under existing building foundations. These risks are expected to be negligible in comparison to present risks. The risks would be reduced with the contingency SVE treatment.
- <i>Adequacy of Controls</i>	No controls would be implemented.	Would not address ongoing source of groundwater contamination. However, it may mitigate potential indoor air exposure.	Excavation and <i>in situ</i> SVE treatment would reduce the contamination.	Excavation and SVE contingency would reduce the contamination.
- <i>Reliability of Controls</i>	No controls would be implemented.	Public education measures and institutional controls could be ignored and/or violated.	Excavation and <i>in situ</i> SVE treatment are permanent remedies.	Excavation and contingency SVE treatment are permanent remedies.
<i>Reduction of Toxicity, Mobility, and/or Volume</i>				
- <i>Treatment Process and Remedy</i>	No treatment would be implemented.	No treatment would be implemented.	Excavation and off-site disposal of PCE-contaminated soil. Installation of extraction wells where vacuum is applied to the soil. This vacuum induces the controlled flow of air to remove VOCs.	Excavation and off-site disposal of PCE-contaminated soil. Pre-treatment may be required. For contingency: installation of extraction wells where vacuum is applied to the soil. This vacuum induces the controlled flow of air to remove VOCs.

Table 4-1 (Sheet 3 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
- <i>Amount of Hazardous Material Treated or Destroyed</i>	No hazardous materials would be treated or destroyed.	No hazardous materials would be treated or destroyed.	Contaminated soils will be treated with SVE and approximately 20 yd ³ will be excavated. Additional soil under Lusardi's Cleaners will be treated with SVE if the contingency is applied.	Approximately 40 yd ³ of contaminated soil would be removed from the site. Additional soil under Lusardi's Cleaners will be treated with SVE if the contingency is applied.
- <i>Reduction of Toxicity, Mobility, and/or Volume</i>	There would be no reduction in toxicity, mobility, and/or volume.	There would be no reduction in toxicity, mobility, and/or volume.	Excavation and <i>in situ</i> treatment reduces the mobility and volume of contaminants as PCE is disposed of and also transferred to GAC. However, there is no reduction in toxicity of contaminants.	Excavation reduces the mobility of contaminants as contaminated soil is disposed in a facility designed to limit mobility. However, there would be no reduction in toxicity or volume of contaminants. SVE treatment of additional contamination would be transferred to GAC and disposed of.
- <i>Irreversibility of Treatment</i>	No treatment would be implemented.	No treatment would be implemented.	Contaminant removal by excavation and SVE are irreversible.	Contaminant removal by excavation and SVE are irreversible.
- <i>Type and Quantity of Residual Wastes</i>	Since no treatment is implemented, no residual waste is generated.	Since no treatment is implemented, no residual waste is generated.	GAC from air treatment would require off-site disposal or regeneration. Approximately 20 yd ³ of contaminated soil would require off-site disposal.	Approximately 40 yd ³ of contaminated soil would require off-site disposal. Contingency GAC from air treatment would require off- site disposal or regeneration.

400099

Table 4-1 (Sheet 4 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

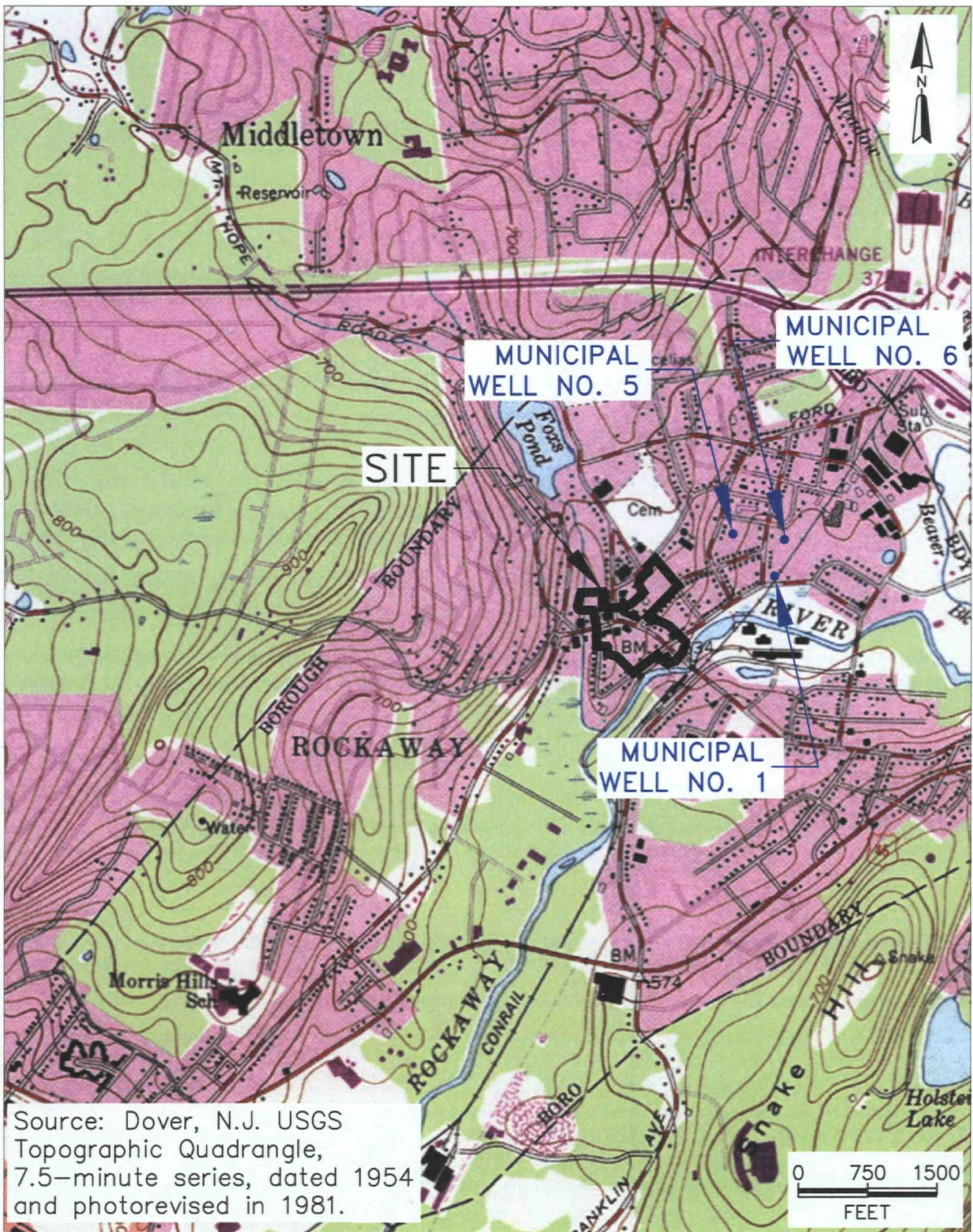
Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
Short-Term Effectiveness				
- <i>Protection of Community During Remedial Activities</i>	Since no treatment is implemented, there are no short-term risks to the community.	Since no treatment is implemented, there are no short-term risks to the community.	Short-term risks to the community relating to inhalation exposure will be mitigated with air monitoring and engineering controls.	Short-term risks to the community relating to exposure to contaminated soil will be mitigated with air monitoring, dust suppression, and restricted site access.
- <i>Protection of Workers During Remedial Activities</i>	Since no treatment is implemented, there are no short-term risks to the workers.	Since no treatment is implemented, there are no short-term risks to the workers.	Short-term risks to workers relating to inhalation exposure will be mitigated with air monitoring and a strong health and safety program.	Short-term risks to workers relating to exposure to contaminated soil will be mitigated with air monitoring, dust suppression, and a strong health and safety program.
- <i>Environmental Effects</i>	Since no treatment is implemented, there will be no environmental effects.	Since no treatment is implemented, there will be no environmental effects.	Excavation is anticipated to create minimal environmental effects since the Site is highly developed. <i>In situ</i> treatment is anticipated to create minimal environmental effects since the Site is highly developed.	Excavation is anticipated to create minimal environmental effects since the Site is highly developed. Contingency <i>in situ</i> treatment is anticipated to create minimal environmental effects since the Site is highly developed.
- <i>Time until Protection Is Achieved</i>	Protection is not achieved.	Protection achieved via institutional controls will require less than 6 months from the time of alternative selection.	Protection achieved via excavation and <i>in situ</i> treatment will require less than three years from the time of alternative selection.	Protection achieved via excavation will require less than one year from the time of alternative selection. Contingency SVE treatment will require less than 2 years.

Table 4-1 (Sheet 5 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
Implementability				
- <i>Ability to Construct and Operate Technology</i>	No construction is involved.	No construction is involved.	Excavation and SVE are proven technologies with readily available construction techniques.	Excavation is a proven technology with readily available construction techniques.
- <i>Reliability of Technology</i>	No technology is involved.	No technology is involved.	SVE is widely used technologies with proven effectiveness with VOCs. With routine O&M, the SVE system is very reliable. Conventional construction equipment is very reliable.	Conventional construction equipment is very reliable. For the contingency, SVE is widely used technologies with proven effectiveness with VOCs. With routine O&M, the SVE system is very reliable.
- <i>Ease of Undertaking Additional Remedial Activities, If Necessary</i>	Additional remedial action could be implemented, if necessary.	Additional remedial action could be implemented, if necessary.	Additional remedial action could be implemented, if necessary and is planned out in the contingency SVE system.	Additional remedial action could be implemented, if necessary and is planned out in the contingency SVE system.
- <i>Monitoring Considerations</i>	No monitoring is required, aside from five-year reviews.	Long-term monitoring of institutional controls is required, in addition to five-year reviews.	Long-term monitoring of institutional controls (if implemented) is required, in addition to five-year reviews.	Long-term monitoring of institutional controls (if implemented) is required, in addition to five-year reviews.
- <i>Coordination with Other Agencies</i>	Coordination with State and Local authorities will be required for five-year reviews.	Coordination with Local and State government will be required for implementing institutional controls and educational programs. Coordination with State and Local authorities will be	Coordination with State and Local government in addition to property owners and tenants will be required for placement of extraction wells, excavation, off-site transportation and associated treatment	Coordination with State and Local government in addition to property owners and tenants will be required for placement of extraction wells, excavation, off-site transportation and associated

Table 4-1 (Sheet 6 of 6)
Rockaway Borough Wellfield Superfund Site
Comparative Analysis of Remedial Alternatives for Soil

Criteria	Alternative S-1 No Action	Alternative S-2 Limited Action	Alternative S-3 <i>In-Situ</i> Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal	Alternative S-4 Excavation with Off-Site Treatment and/or Disposal with SVE
		required for five-year reviews.	equipment. Air equivalencies will be required. Building permits may also be required.	treatment equipment. Air equivalencies will be required. Building permits may also be required.
- <i>Availability of Treatment Capacity and Disposal Services</i>	No treatment or disposal is required.	No treatment or disposal is required.	Off-site disposal or regeneration facilities are available to accept the GAC. Off-site disposal facilities are available to accept the contaminated soil.	Off-site disposal facilities are available to accept the contaminated soil. For the contingency plan, off-site disposal or regeneration facilities are available to accept the GAC.
- <i>Availability of Necessary Equipment and Specialists</i>	No equipment and specialists are required.	No equipment is required. Consulting specialists are readily available.	Since SVE and excavation are widely used, necessary equipment and experienced personnel are readily available. Consulting specialists are also readily available.	Since SVE and excavation are widely used, necessary equipment and experienced personnel are readily available. Consulting specialists are also readily available.
- <i>Availability of Technologies</i>	No technology is involved.	No technology is involved.	Since SVE and excavation are widely used, the technology is available for competitive bidding.	Since excavation and SVE are widely used, the technology is available for competitive bidding.
Costs				
- <i>Total Capital Cost (\$)</i>	0	27,000	360,000	46,000
- <i>Annual O&M Cost (\$/year)</i>	0	0	0	0
- <i>Present Worth (\$)</i>	0	27,000	360,000	46,000
- <i>Contingency (\$)</i>	0	0	50,000	274,000



TETRA TECH EC, INC.

TITLE:
 SITE LOCATION MAP
 FEASIBILITY STUDY REPORT
 ROCKAWAY BOROUGH WELLFIELD RI/FS

DWN:
 CTS

CHKD:
 BS

DATE:
 4/15/04

DES.:
 CTS

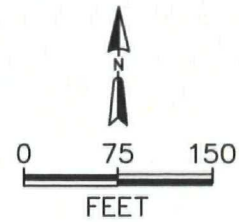
APPD:
 LH

REV.:
 0

PROJECT NO.:
 1945.2144

FIGURE NO.:
 1-1

400104



LEGEND

- APPROXIMATE FOOTPRINT OF THE FORMER MORRIS CANAL
- SITE STUDY AREA BOUNDARY



TETRA TECH EC, INC.

TITLE:

STUDY AREA
FEASIBILITY STUDY REPORT
ROCKAWAY BOROUGH WELLFIELD RI/FS – WALL STREET/EAST MAIN STREET SITE

DWN.:

CTS

DATE:

6/2/06

PROJECT NO.:

1945.2144

CHKD.:

BS

REV.:

0

FIGURE NO.:

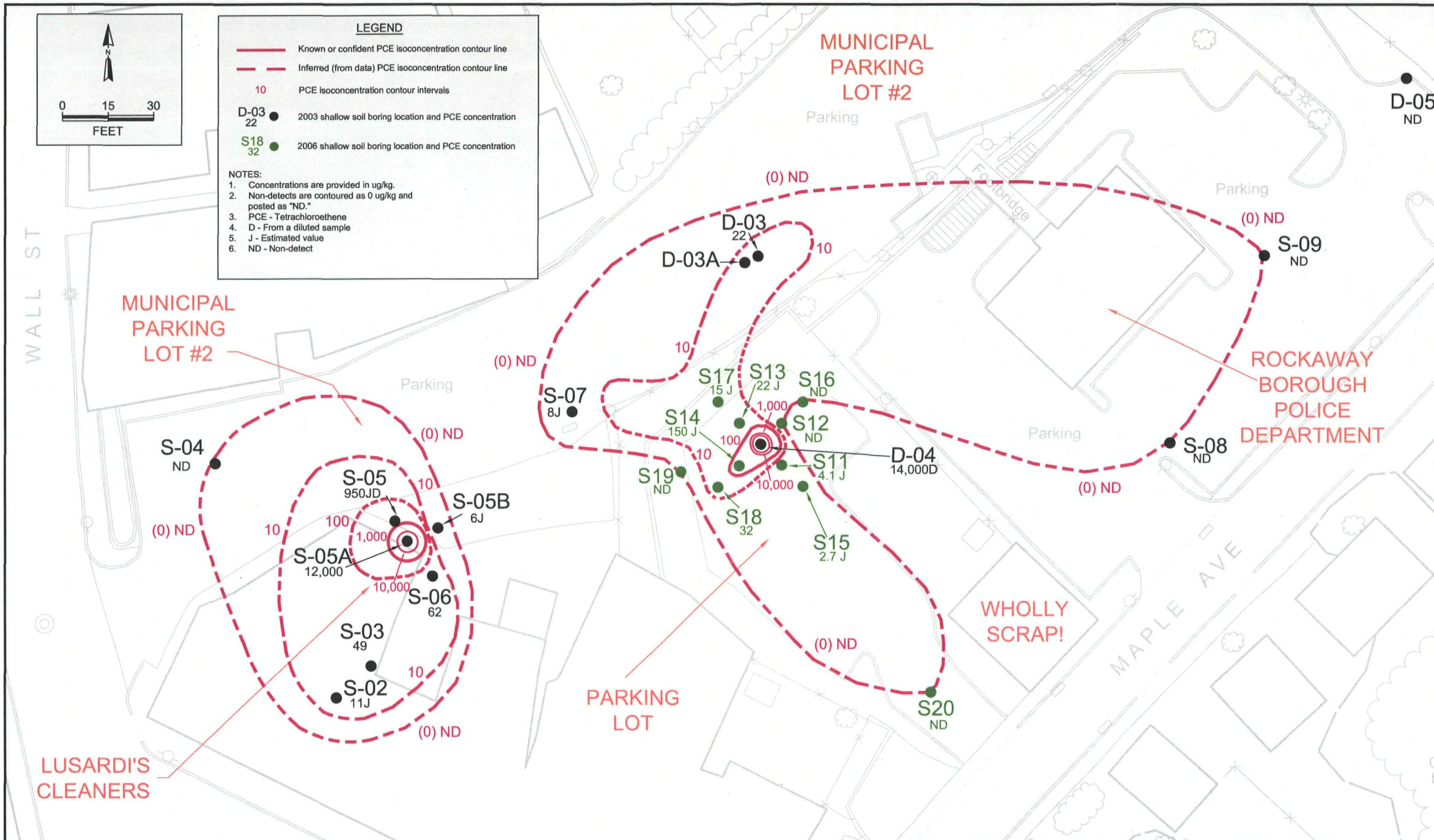
1-2

DES.:

CTS

APPD.:

LH



TETRA TECH EC, INC.

TITLE:

TETRACHLOROETHENE IN SURFACE SOIL—INCLUDING 2006 SUPPLEMENTAL DATA
WALL STREET/EAST MAIN STREET AREA
ROCKAWAY BOROUGH WELLFIELD SUPERFUND SITE RI/FS

DWN.:

LMB

DATE:

7/7/2006

PROJECT NO.:

1945.2144

CHKD:

LHH

REV.:

0

FIGURE NO.:

1-3

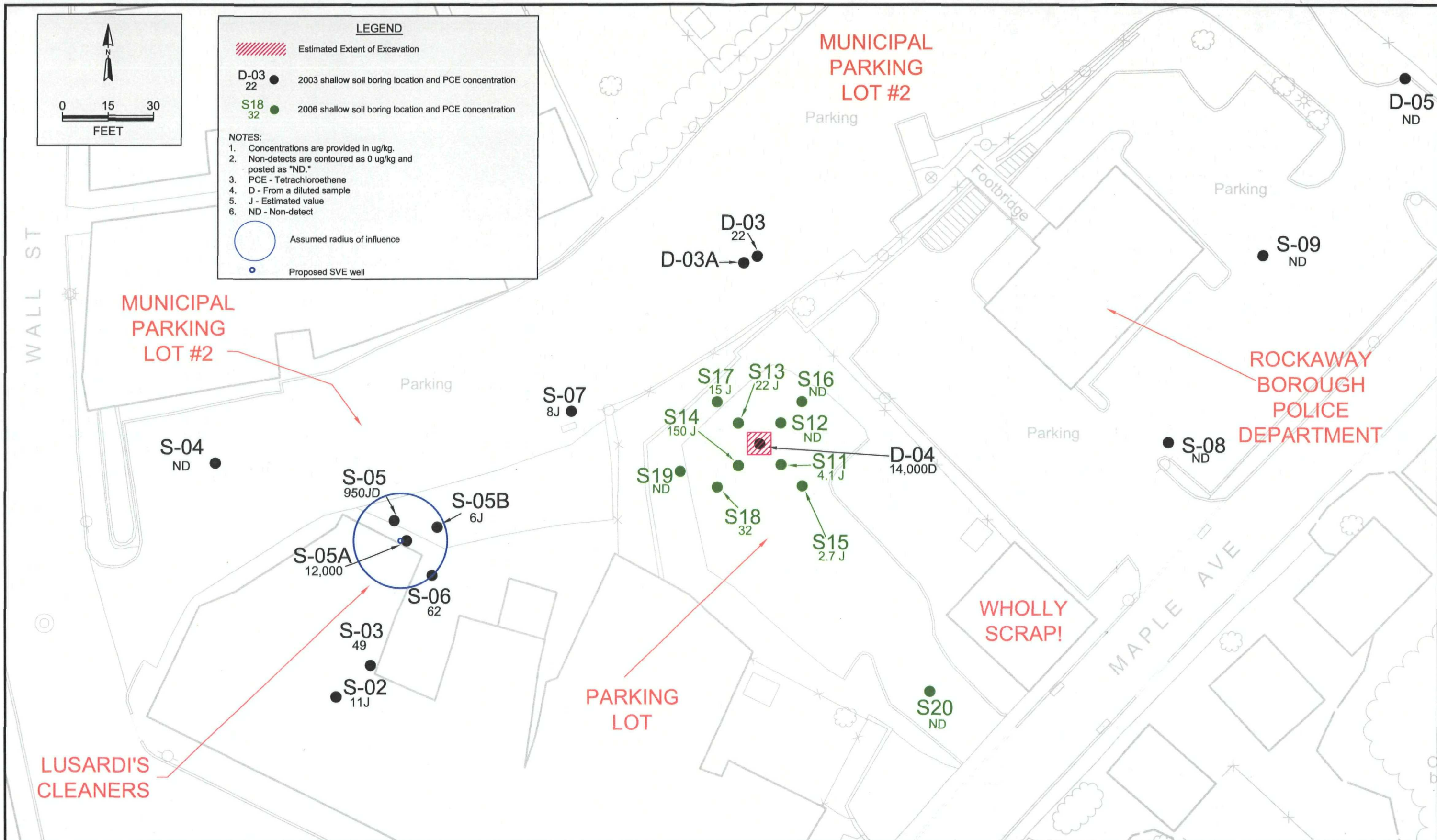
DES.:

EEP

APPD:

LHH

400106



TETRA TECH EC, INC.

TITLE:

HOT SPOT EXCAVATION AND CONCEPTUAL SVE SYSTEM LAYOUT (ALTERNATIVE S-3)
WALL STREET/EAST MAIN STREET AREA
ROCKAWAY BOROUGH WELLFIELD SUPERFUND SITE RI/FS

DWN.:

LMB

DATE:

8/3/06

PROJECT NO.:

1945.2144

CHKD.:

LHH

REV.:

0

FIGURE NO.:

4-1

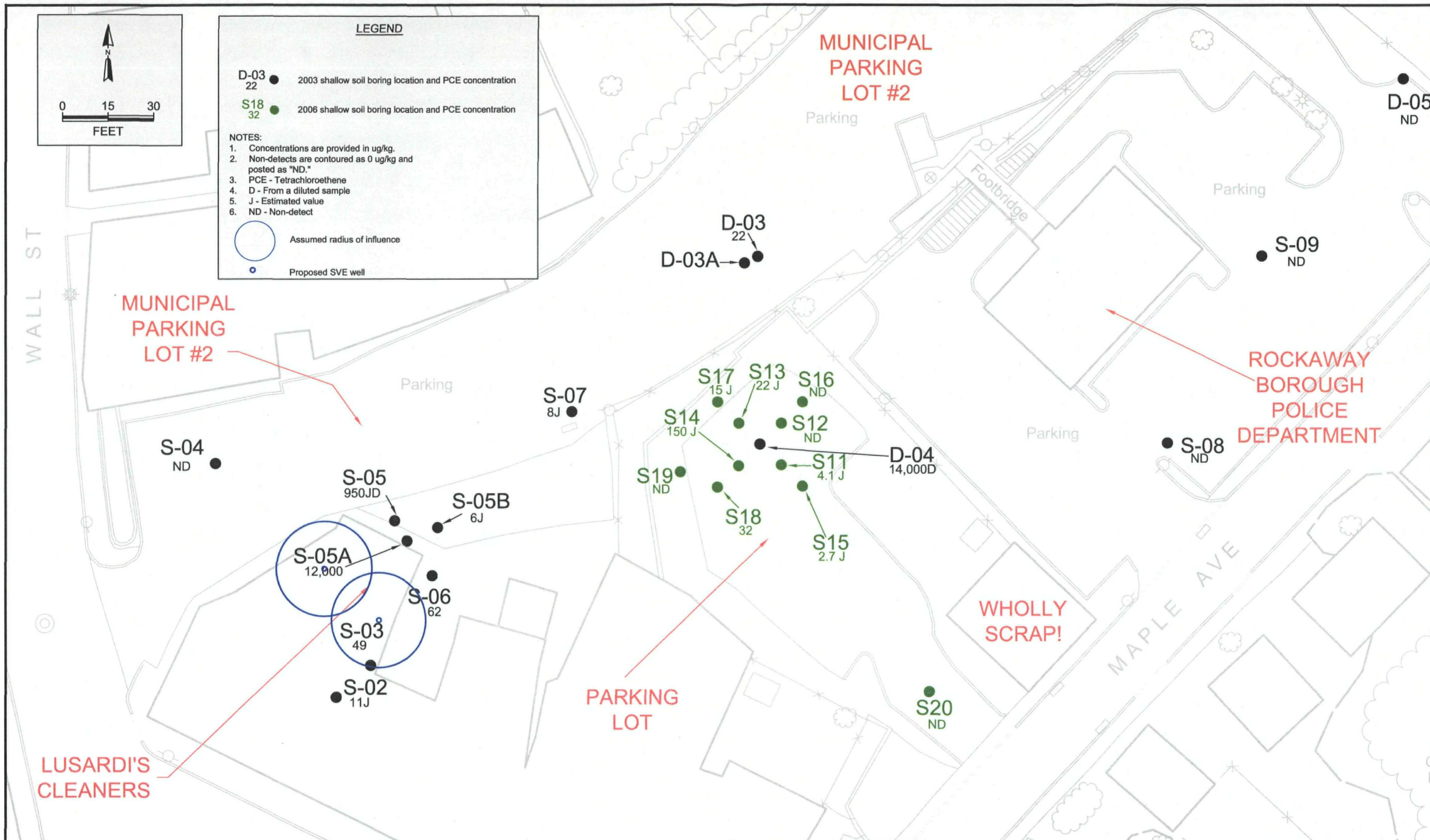
DES.:

EEP

APPD.:

LHH

400107



TETRA TECH EC, INC.

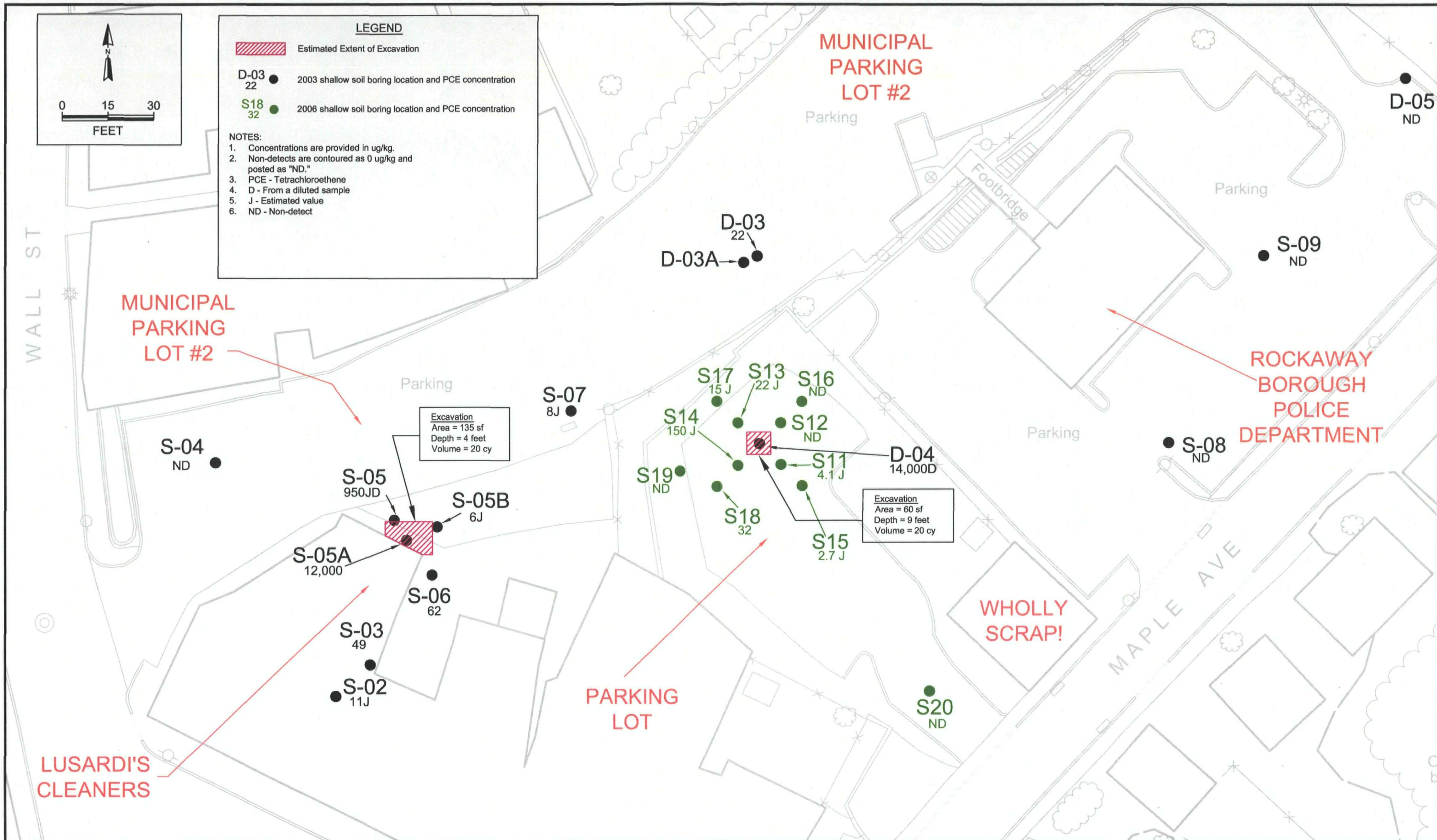
TITLE:
 CONTINGENCY SVE SYSTEM LAYOUT
 WALL STREET/EAST MAIN STREET AREA
 ROCKAWAY BOROUGH WELLFIELD SUPERFUND SITE RI/FS

DWN.: LMB	DATE: 8/3/06
CHKD: LHH	REV.: 0
DES.: EEP	APPD: LHH

PROJECT NO.:
1945.2144

FIGURE NO.:
4-2

400108



TETRA TECH EC, INC.

TITLE:
CONCEPTUAL EXCAVATION AREA (ALTERNATIVE S-4)
WALL STREET/EAST MAIN STREET AREA
ROCKAWAY BOROUGH WELLFIELD SUPERFUND SITE RI/FS

DWN.: LMB	DATE: 8/3/06
CHKD: LHH	REV.: 0
DES.: EEP	APPD: LHH

PROJECT NO.:
1945.2144

FIGURE NO.:
4-3

400109

APPENDIX A
Major Facilities and Construction Components

TABLE A-1
Rockaway Borough Wellfield Superfund Site
Alternative S-1: No Action
Major Facilities and Construction Components

<u>FACILITY/CONSTRUCTION</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
------------------------------	---------------------------------	--------------	--------------------

No Remedial Action			
--------------------	--	--	--

TABLE A-2
Rockaway Borough Wellfield Superfund Site
Alternative S-2: Limited Action
Major Facilities and Construction Components

<u>FACILITY/CONSTRUCTION</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
------------------------------	---------------------------------	--------------	--------------------

No Remedial Action			
--------------------	--	--	--

TABLE A-3
Rockaway Borough Wellfield Superfund Site
Alternative S-3: *In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal
Major Facilities and Construction Components

<u>FACILITY/CONSTRUCTION</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
I. ASPHALT CAP			
1. Clearing and Grubbing	135	sf	Assume part of site not under pavement.
2. Asphalt Pavement Cap	135	sf	Assume minor clearing and grubbing in grassy area. Area capped with 6" asphalt pavement.
II. SOIL VAPOR EXTRACTION			
Well Installation			
1. Drilling (8" HSA)	11	LF	Drill 1 well to a depth of approximately 10 ft. Estimated quantity includes 10% extra for wastage.
2. Casing (4" PVC)	5	LF	Casing for 1 well.
3. Well Screen (4" Dia)	5	LF	1 ft. screens for 1 well.
4. Electricity	150,000	kwh	10 hp blower operated for 2 years
SVE System and Contingency SVE System			
1. Equipment and Installation	2	ea	Includes poly liner, SVE blowers, moisture separators, and carbon units (2 per year).
2. Equipment Maint.	2	yr	Maintenance of SVE equipment for 2 years.
3. Operational Labor	730	day	Operational labor for 2 years.
4. Power	24	mo	Power requirements for 2 years.
III. EXCAVATION			
1. Asphalt Removal	1	cy	Assume site under 6" asphalt pavement

TABLE A-3
Rockaway Borough Wellfield Superfund Site
Alternative S-3: *In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal
Major Facilities and Construction Components

<u>FACILITY/CONSTRUCTION</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
2. Excavation	20	cy	Excavate soils where PCE > 1000 ppb. Estimated quantity of excavated soil area (60 ft ²) to a depth of 9 ft. at the Wholly Scrap! site.
3. Clean Fill	20	cy	Clean soil for into excavated areas. Estimated volume includes 25% fluff.
4. Compaction	20	cy	Mechanical compaction of clean fill.
5. Pavement (6" asphalt)	60	Sq. ft.	Cover excavated area with 6" thick asphalt.

TABLE A-4
Rockaway Borough Wellfield Superfund Site
Alternative S-4: Excavation with Off-Site Treatment and/or Disposal with SVE
Major Facilities and Construction Components

<u>FACILITY/CONSTRUCTION</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
I. EXCAVATION			
1.Asphalt Removal	3	cy	Assume two sites under 6" asphalt pavement
2.Excavation	40	cy	Excavate soils where PCE > 1000 ppb. Estimated quantity of excavated soil area (60 ft ²) to a depth of 9 ft. at the Wholly Scrap! site and area (135 ft ²) to a depth of 4 ft. at the Lusardi's Cleaners site.
3.Clean Fill	42	cy	Clean soil for into excavated areas. Estimated volume includes 25% fluff.
4.Compaction	42	cy	Mechanical compaction of clean fill.
5.Pavement (6" asphalt)	3	cy	Cover excavated area with 6" thick asphalt.
II. OFF-SITE DISPOSAL			
1.Non-Hazardous Waste	56	ton	Transport and dispose soil and asphalt in an approved off-site permitted treatment, storage, and disposal facility as non-hazardous waste.
III. CONTINGENCY SVE SYSTEM			
1.Equipment and Installation	2	ea	Includes poly liner, SVE blowers, moisture separators, and carbon units (2 per year).
2.Equipment Maint.	2	yr	Maintenance of SVE equipment for 2 years.
3.Operational Labor	730	day	Operational labor for 2 years.
4.Power	24	mo	Power requirements for 2 years.

APPENDIX B

APPENDIX B
Conceptual Costs

Table B-1
 Rockaway Borough Wellfield Superfund Site
 Remedial Alternative Cost Estimate
 Alternative S-1 (No Action)

Estimated Quantities	Units	Labor		Equipment		Material		Total Construction Costs
		Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
No Action		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Present Worth								\$0.00

400119

Table B-2
Rockaway Borough Wellfield Superfund Site
Remedial Alternative Cost Estimate
Alternative S-2 (Limited Action)

	Estimated Quantities	Units	Labor		Equipment		Material		Total Costs
			Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
Deed Notice									
Legal Support	100	hours	\$175.00	\$17,500	\$0.00	\$0	\$0.00	\$0	\$17,500
Technical Support	40	hours	\$125.00	\$5,000	\$0.00	\$0	\$0.00	\$0	\$5,000
Total Direct Construction Costs (TDCC)									\$22,500
Contingency at 20%									\$4,500
Engineering and Construction Management @ 15% of TDCC (excluding Legal/Technical Support)									\$0
Other Legal and Administrative @ 5% of TDCC (excluding Legal/Technical Support)									\$0
Total Capital Cost									\$27,000
Total Present Worth									\$27,000

Cost Estimate Assumptions:

Legal support includes development and implementation of institutional control, including public meetings, etc.

Table B-3 (Page 1)
Rockaway Borough Wellfield Superfund Site
Remedial Alternative Cost Estimate
Alternative S-3 (*In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal)

	Estimated Quantities	Units	Labor		Equipment		Material		Total Construction Costs
			Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
Pre-Design Investigation									
Archeological/Historical Monitoring	1	day	\$800.00	\$800	\$0.00	\$0	\$50.00	\$50	\$850
SVE Pilot Study	1	LS	\$20,000.00	\$20,000	\$15,000.00	\$15,000	\$5,000.00	\$5,000	\$40,000
<i>In Situ</i> SVE Treatment									
SVE Well Installation	1	well	\$1,000.00	\$1,000	\$0.00	\$0	\$200.00	\$200	\$1,200
SVE System Installation/Operation	1	each	\$80,000.00	\$80,000	\$60,000.00	\$60,000	\$20,000.00	\$20,000	\$160,000
Confirmatory Sampling	5	each	\$160.00	\$800	\$0.00	\$0	\$60.00	\$300	\$1,100
Air Monitoring (well installation)	1	day	\$400.00	\$400	\$80.00	\$80	\$84.60	\$85	\$565
Electricity	150,000	kwh	\$0.00	\$0	\$0.00	\$0	\$0.20	\$30,000	\$30,000
Hot Spot Excavation									
Asphalt Removal	1	cu yd	\$25.00	\$27	\$0.00	\$0	\$0.00	\$0	\$27
Excavation	20	cu yd	\$2.95	\$58	\$2.21	\$43	\$0.00	\$0	\$101
Air Monitoring	1	day	\$400.00	\$400	\$80.00	\$80	\$84.60	\$85	\$565
Clean Fill	20	cu yd	\$4.00	\$78	\$3.04	\$59	\$17.23	\$336	\$473
Asphalt Replacement	60	sq ft	\$0.66	\$40	\$0.06	\$4	\$1.41	\$85	\$128
Confirmatory Sampling	5	ea	\$80.00	\$400	\$0.00	\$0	\$60.00	\$300	\$700
Off-site disposal (asphalt)	2	ton	\$25.00	\$55	\$0.00	\$0	\$0.00	\$0	\$55
Off-site disposal (soil)	29	ton	\$75.00	\$2,194	\$0.00	\$0	\$0.00	\$0	\$2,194
Deed Notice									
Legal Support	100	hours	\$175.00	\$17,500	\$0.00	\$0	\$0.00	\$0	\$17,500
Technical Support	40	hours	\$125.00	\$5,000	\$0.00	\$0	\$0.00	\$0	\$5,000
Total Direct Construction Costs (TDCC)									\$260,457
Contingency at 20% of TDCC									\$52,091
Engineering and Construction Management @ 15% of TDCC (excluding Legal/Technical Support)									\$35,693
Other Legal and Administrative @ 5% of TDCC (excluding Legal/Technical Support)									\$11,898
Total Capital Cost									\$360,139
Total Present Worth									\$360,139

SVE Cost Estimate Assumptions:

Air monitoring and archeological monitoring days based on installation rate of 1 well/day

Air monitoring cost based on daily rental of air monitoring equipment

Confirmatory sampling based on approximately 1 sample per 1000 square feet of remediated area for each 2 ft. interval; collected with direct-push technology; analyzed for PCE only

Electricity cost based on use of a 10 hp blower used for 2 years

400121

Table B-3 (Page 2)
Rockaway Borough Wellfield Superfund Site
Remedial Alternative Cost Estimate
Alternative S-3 (*In-Situ* Remediation (SVE) and Hot-Spot Excavation with Off-Site Treatment and/or Disposal)

Excavation Cost Assumptions:

Approximately 60 sf remediation area covered with asphalt 6" thick
Excavation cost assumes conventional excavation equipment and no shoring or dewatering required
Air monitoring and archeological monitoring days based on one per excavation site (1 site, one site per day)
Air monitoring cost based on daily rental of air monitoring equipment
Off-site disposal cost assumes soils are non-hazardous
Off-site disposal tonnage based on 1.5 tons per cy of excavated soil, 2 tons per cy of asphalt
Confirmatory sampling based on approximately 1 sample per 30 foot of sidewall plus one per 900 foot of excavation bottom; analyzed for PCE only

Legal support includes development and implementation of institutional control, including public meetings, etc.

	Estimated Quantities	Units	Labor		Equipment		Material		Total Construction Costs
			Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
Potential Future Remedial Action									
SVE well installation	2	wells	\$1,000.00	\$2,000	\$0.00	\$0	\$200.00	\$400	\$2,400
Air Monitoring (well installation)	2	day	\$400.00	\$800	\$80.00	\$160	\$84.60	\$169	\$1,129
Confirmatory Sampling	10	each	\$160.00	\$1,600	\$0.00	\$0	\$60.00	\$600	\$2,200
Electricity	150,000	kwh	\$0.00	\$0	\$0.00	\$0	\$0.20	\$30,000	\$30,000
Total Direct Construction Costs (TDCC)									\$35,729
Contingency at 20% of TDCC									\$7,146
Engineering and Construction Management @ 15% of TDCC									\$5,359.38
Other Legal and Administrative @ 5% of TDCC									\$1,786
Total Capital Cost									\$50,021
Total Present Worth									\$50,021

Future Work Assumptions

2 SVE wells installed in Lusardi's basement; operating system remains from first well installation
Air monitoring days based on installation rate of 1 well/day
Air monitoring cost based on daily rental of air monitoring equipment
Confirmatory sampling based on approximately 1 sample per 1000 square feet of remediated area for each 2 ft. interval; collected with direct-push technology; analyzed for PCE only
Electricity based on use of 10 hp blower

Table B-4 (Page 1)
 Rockaway Borough Wellfield Superfund Site
 Remedial Alternative Cost Estimate
 Alternative S-4 (Excavation with Off-Site Treatment and/or Disposal with SVE)

	Estimated Quantities	Units	Labor		Equipment		Material		Total Construction Costs
			Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
Pre-Design Investigation									
Archeological/Historical Monitoring	2	day	\$800.00	\$1,600	\$0.00	\$0	\$50.00	\$100	\$1,700
Excavation									
Asphalt Removal	4	cu yd	\$25.00	\$89	\$0.00	\$0	\$0.00	\$0	\$89
Excavation	40	cu yd	\$2.95	\$117	\$2.21	\$87	\$0.00	\$0	\$204
Air Monitoring	2	day	\$400.00	\$800	\$80.00	\$160	\$84.60	\$169	\$1,129
Clean Fill	40	cu yd	\$4.00	\$160	\$3.04	\$122	\$17.23	\$689	\$971
Asphalt Replacement	195	sq ft	\$0.66	\$129	\$0.06	\$12	\$1.41	\$275	\$415
Confirmatory Sampling	10	ea	\$80.00	\$800	\$0.00	\$0	\$60.00	\$600	\$1,400
Off-site disposal (asphalt)	7	ton	\$25.00	\$179	\$0.00	\$0	\$0.00	\$0	\$179
Off-site disposal (soil)	59	ton	\$75.00	\$4,444	\$0.00	\$0	\$0.00	\$0	\$4,444
Deed Notice									
Legal Support	100	hours	\$175.00	\$17,500	\$0.00	\$0	\$0.00	\$0	\$17,500
Technical Support	40	hours	\$125.00	\$5,000	\$0.00	\$0	\$0.00	\$0	\$5,000
Total Direct Construction Costs (TDCC)									\$33,031
Contingency at 20% of TDCC									\$6,606
Engineering and Construction Management @ 15% of TDCC									\$4,955
Other Legal and Administrative @ 5% of TDCC									\$1,652
Total Capital Cost									\$46,244
Total Present Worth									\$46,244

Cost Estimate Assumptions:

Approximately 170 sf remediation area covered with asphalt 6" thick
 Excavation cost assumes conventional excavation equipment and no shoring or dewatering required
 Air monitoring and archeological monitoring days based on one per excavation site (2 sites, one site per day)
 Air monitoring cost based on daily rental of air monitoring equipment
 Off-site disposal cost assumes soils are non-hazardous
 Off-site disposal tonnage based on 1.5 tons per cy of excavated soil, 2 tons per cy of asphalt
 Confirmatory sampling based on approximately 1 sample per 30 foot of sidewall plus one per 900 foot of excavation bottom; analyzed for PCE only

Legal support includes development and implementation of institutional control, including public meetings, etc.

400123

Table B-4 (Page 2)
Rockaway Borough Wellfield Superfund Site
Remedial Alternative Cost Estimate
Alternative S-4 (Excavation with Off-Site Treatment and/or Disposal with SVE)

	Estimated Quantities	Units	Labor		Equipment		Material		Total Construction Costs
			Unit Price	Cost	Unit Price	Cost	Unit Price	Cost	
Potential Future Remedial Action									
SVE well installation	2	wells	\$1,000.00	\$2,000	\$0.00	\$0	\$200.00	\$400	\$2,400
SVE System Installation/Operation	1	each	\$80,000.00	\$80,000	\$60,000.00	\$60,000	\$20,000.00	\$20,000	\$160,000
Air Monitoring (well installation)	2	day	\$400.00	\$800	\$80.00	\$160	\$84.60	\$169	\$1,129
Confirmatory Sampling	10	each	\$160.00	\$1,600	\$0.00	\$0	\$60.00	\$600	\$2,200
Electricity	150,000	kwh	\$0.00	\$0	\$0.00	\$0	\$0.20	\$30,000	\$30,000
Total Direct Construction Costs (TDCC)									\$195,729
Contingency at 20% of TDCC									\$39,146
Engineering and Construction Management @ 15% of TDCC									\$29,359.38
Other Legal and Administrative @ 5% of TDCC									\$9,786
Total Capital Cost									\$274,021
Total Present Worth									\$274,021

Future Work Assumptions

2 SVE wells installed in Lusardi's basement; system installation required

Air monitoring days based on installation rate of 1 well/day

Air monitoring cost based on daily rental of air monitoring equipment

Confirmatory sampling based on approximately 1 sample per 1000 square feet of remediated area for each 2 ft. interval; collected with direct-push technology; analyzed for PCE only

Electricity based on use of 10 hp blower for 2 years

APPENDIX C
Archeological Trip Report



TETRA TECH EC, INC.

MEMORANDUM

TO: Louis Hahn

DATE: June 13, 2006

FROM: Stuart A. Reeve, Ph.D.

SUBJECT: Archeological Monitoring During Focused Field Sampling at the Rockaway Borough Wellfield Superfund Site, Wall Street/East Main Street Area, Rockaway Borough, Morris County, New Jersey

On April 19, 2006, an archeologist from Tetra Tech EC, Inc. (TtEC) monitored soil borings at 21 Maple Avenue, Rockaway Borough, during the focused field sampling for the remedial investigation feasibility study at the Rockaway Borough Wellfield Superfund Site, Wall Street/East Main Street Area, Rockaway Borough, New Jersey. Archeological monitoring was conducted to observe possible adverse effects on cultural resources, such as historical archeological sites, that might be eligible for listing on the National Register of Historic Places. Historically, the stone structure at 21 Maple Avenue was built in 1844, and formerly contained offices for the Union Foundry (Reeve, 2002). A coal shed and other outbuildings occupied areas of the present parking lot at 21 Maple Avenue where focused field sampling was conducted. Former building locations are indicated by variations in stone retaining walls along the north side of the property. The standing stone structure at 21 Maple Avenue is within the Halsey-Maple Worker's Historic District (Acroterion, 1986; HPO 1434-29). This property is directly south of the historic Morris Canal, built in 1826 and listed on the National Register of Historic Places (Kalata, 1983). The Morris Canal prism was abandoned in 1924, and lies beneath Dock Street and the municipal parking lot immediately north of the lot at 21 Maple Avenue.

Ten (10) direct-push soil borings (S11 to S20) were extracted in the vicinity of the parking lot at 21 Maple Avenue. The soil borings were 1.5-inch in diameter, extracted in clear acetate tubes, and were approximately four feet in depth. Eight of the soil borings (S11 to S18) were located within a 20-foot radius of previously dug drill hole D4 (Reeve, 2003). Soil boring S19 was located approximately 30 feet to the west of D4, and S20 was located approximately 100 feet south of D4. Acetate tubes were cut open to extract soil samples for analyses of possible hazardous materials. Soil samples in acetate tubes were inspected using trowels (not screened) for cultural materials.

All the soil cores were similar, including 12 to 24 inches below surface of brown sandy fill with coal and gravel, a cobble layer at the base of the fill, and yellowish brown sand and cobbles from glacial till extending to a depth of approximately 48 inches below surface. No industrial soil deposits were observed, such as layers of dense coal cinders or

400127

iron slag that might have related to former activities at the Union Foundry. No structural foundation features were identified in the soil borings relating to historic outbuildings.

In conclusion, archeological monitoring of ten soil borings at 21 Maple Avenue identified no significant archeological sites. TtEC found that soil boring had no adverse effects on cultural resources.

References

Acroterion, 1986. Rockaway Borough. Morris County Resources Survey, Morris County Heritage Commission, Morristown, NJ.

Kalata, Barbara N., 1973. *The Morris Canal*. National Register of Historic Places Nomination Form. On file, New Jersey Historic Preservation Office, Trenton, NJ.

Reeve, Stuart A., 2002. *Stage 1A Cultural Resource Investigation Wall Street/East Main Street Site, Rockaway Borough, Morris County New Jersey*. Prepared for U.S. Environmental Protection Agency, Region 2. Prepared by Foster Wheeler Environmental Corporation, Morris Plains, NJ

Reeve, Stuart A., 2003. *Archeological Monitoring for Remedial Investigation/Feasibility Study Rockaway Borough Wellfield Superfund Site, Wall Street/East Main Street Site Rockaway Borough, Morris County New Jersey*. Prepared for U.S. Environmental Protection Agency, Region 2. Prepared by Foster Wheeler Environmental Corporation, Morris Plains, NJ



TETRA TECH EC, INC.

400129